COMBATING BIOLOGICAL TERRORISM FROM IMPORTED FOOD

THESIS

Jeffrey S. Nelson, Major, USA

AFIT/GWM/ENP/11-M04

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

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Jeffrey S. Nelson, MS

Major, USA

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Jeffrey S. Nelson, MS

Major, USA

Approved:

//SIGNED//___________________________ __________________
Charles A. Bleckmann, PhD (Chairman) Date

//SIGNED//___________________________ __________________
LTC Eugene V. Sheely (Member) Date

//SIGNED//___________________________ __________________
Timothy S. Webb, PhD (Member) Date

AFIT/GWM/ENP/11-M04

Abstract

There is a threat that a terrorist or terrorist organization will use access to the US food supply to kill or sicken Americans by contaminating imported food products from Mexico. The food that Americans eat is coming more and more often from foreign countries such as Mexico. Foodborne diseases infect nearly fifty million people in the US each year, resulting in over three thousand deaths. There are many terrorist organizations that would like to deliberately contaminate American food. Drug cartels and terrorist organizations currently operate in Mexico, one of the leading food importers into the US. The purpose of this research was to determine what actions should be taken in response to the threat of biological terrorism through deliberately-contaminated food supplied from Mexico.

While Americans enjoy the safest and most abundant food supply in the world, this thesis made several recommendations. First, laboratories and public health officers should continue to increase their ability to detect and identify foodborne outbreaks. Second, consumers who become sickened by foodborne pathogens should report their sickness to either the local hospital or to the local health department even if they choose to treat the sickness at home. Third, the US should increase the production of food that Americans eat with the goal of producing a self sufficient food supply. Fourth, consumers should be better informed on food safety issues to minimize the effects of bioterrorism.

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Jeffrey S. Nelson

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I. Introduction

General Issue

Foreign Food

The food that Americans eat is coming more and more often from foreign countries. The value of US imports of agricultural products rose from $10.491 billion in 1976 to $73.865 billion in 2010 (ERS, 2010b; Appendix A). See Figure 1. About 80% of seafood, 50% of fruits, and 50% of nuts are now imported (Buckley, 2010). With a workforce willing to work for less pay, some foreign countries, such as Mexico and China, can produce foods cheaper abroad than we can in the US. Also, some food products, such as cocoa beans for chocolate production, cannot be grown in the US (Jerardo, 2008).

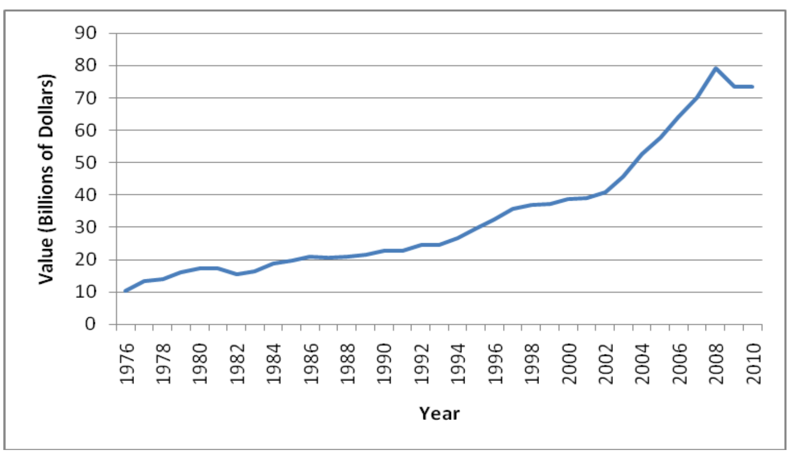

Figure 1. Value of US Agricultural Imports by Year (ERS, 2011)

Foodborne Pathogens

"Food carries with it the risk of foodborne illness" (Buckley, 2010:9). The Centers for Disease Control and Prevention (CDC) identified and categorized biological agents, including several foodborne pathogens, as possible agents that could be used for bioterrorism (CDC, "Bioterrorism", 2010d). The Category A agents, or those agents assigned a higher priority due to their high mortality rates, include *Bacillus anthracis*, which causes anthrax, and *Clostridium botulinum*, which causes botulism. For example, the oral lethal dose for botulinum toxin is only 70 micrograms (Arnon, et al., 2001; AAOS, 2005:1117). While these two biological organisms are more dangerous if used, most foodborne pathogens are classified as Category B agents because they would cause moderate morbidity and low mortality rates. These agents include *Salmonella* species, *Escherichia. coli* O157:H7, and *Shigella dysenteriae*. These organisms have the capability to kill or sicken those that are infected by them.

In January 2011, the CDC released new estimates on the effects of foodborne diseases. The CDC estimates that, each year, about 47.8 million people, which is about one in six US citizens, becomes sick from foodborne diseases. Of those, nearly 128,000 people become hospitalized with over 3,000 deaths. Of the 47.8 million annual illnesses, 31 known foodborne pathogens cause over 9 million illnesses. The remaining 38 million illnesses, or 80 percent of the total illnesses, result from agents that cannot be determined because there is not enough data to specify an agent or that the agent has not been discovered or recognized as a foodborne pathogen (Scallan, et al., 2011; Appendix B). The CDC determined that *Salmonella* was the leading cause of hospitalizations (35 percent) and deaths (28 percent) of the known foodborne pathogens. The seven most

influential pathogens are *Salmonella*, norovirus, *Campylobacter, Toxoplasma*, *E. coli* O157, *Listeria*, and *Clostridium perfringens* and are responsible for about 90 percent of the estimated illnesses, hospitalizations, and deaths. Norovirus causes 5.5 million, or 58 percent, of the foodborne illnesses (Scallan, et al., 2011; Appendix C).

Terrorism

There are many enemies of the US that would like to cause terrorism within the country. The Secretary of State has determined that four nations, Cuba, Iran, Sudan, and Syria, are state sponsors of terrorism (DOS, 2009). North Korea was a member of President George W. Bush's "Axis of Evil" with Libya included on a subsequent list named "Beyond the Axis of Evil." Both were previously on the list of nations sponsoring terrorism. China, Russia, and Venezuela might also enjoy hurting the US. Al Qaeda and many other terrorist organizations (DOS, 2010b; Appendix D) have also targeted Americans in the past. In fact, the *Washington Times* reported that the terrorist group Hezbollah, the same organization that killed 241 American servicemen with a truck bomb at a Marine barracks in Beirut in 1983 (CDI, 2010), is currently operating in Mexico (*Washington Times*, 2009).

Food Terrorism Defined

Many sources use the definition for food terrorism used by the World Health Organization, or WHO:

> "an act or threat of deliberate contamination of food for human consumption with biological, chemical and physical agents or radionuclear materials for the purpose of causing injury or death to civilian populations and/or disrupting social, economic or political stability. The biological agents referred to are communicable infectious or non-infectious pathogenic microorganisms, including viruses, bacteria and parasites" (WHO, 2008:4).

Mexico

Mexico is an important country to the US, perhaps the most important and the most influential. Mexico's relationship with the US has a direct impact on the lives and livelihoods of millions of Americans in the form of trade, homeland security, drug control, or migration. This becomes apparent when one realizes that nearly one million people and one billion dollars worth of commerce cross the US-Mexico border daily. One million Americans live in Mexico with over 18,000 companies with US investment there (which is more than 40% of all foreign direct investment in Mexico). Local and state governments on both sides of the 2,000-mile border are required to interact closely to properly serve their citizens. To combat terrorism and control the flow of illegal drugs into the US, it is critical to have a strong partnership with Mexico (Bureau of Western Hemispheric Affairs, 2010b).

Any discussion about Mexican operations must include a discussion about Mexican drug cartels. Within Mexico, drug cartels depend upon American consumers for their financial support. The cartels could violently respond to any threat to their livelihood. Mexican drug cartels have responded to increased pressure on their activities with increased and unprecedented levels of hostility aimed at both the government's security forces and each other. Narcotics-related violence killed over 8,000 people in 2009, most in states along the US border. More than 400 of Mexico's security forces members were killed. Almost 23,000 people have died in the war on drugs since Mexican President Calderon took office in December 2006 (Bureau of Western Hemispheric Affairs, 2010b).

Problem Statement

These drug cartels, or any of these nations or organizations mentioned above, could commit a biological attack on the US. While the US imports food from many countries, this study is limited to that food which is imported from Mexico. There is a threat that a terrorist or terrorist organization will use access to the US food supply to kill or sicken Americans by contaminating imported food products from Mexico. What actions should be taken in response to the threat of biological terrorism through deliberately-contaminated food supplied from Mexico?

Research Objective

With the threat that a terrorist or terrorist organization will use access to the food supply into the US to kill or sicken Americans by contaminating imported food products from Mexico, this study sought to determine which actions should be taken in response to the threat of biological terrorism through deliberately-contaminated food supplied from Mexico.

Investigative Questions

To answer the research objective, this study answered the following investigative questions:

What pathogens are available for use in a foodborne bioterrorism attack?
Which terrorist organizations could execute this bioterrorist attack?
What food, and how much, does Mexico export into the US?
How do the Mexican farmers transport their food into the US?
Where along the food production process could a terrorist contaminate the food with foodborne pathogens?
What are the effects that a foodborne bioterrorism attack could cause?

Methodology

Much of the research for this study was conducted by a literature review. There exists much literature, both printed and online, that addressed and answered the investigative questions. Some of this information came from departments and agencies under the federal, state, or other governments, while other information came from professional organizations and other sources. For information not found in published documents, organizations or experts in that particular field were contacted directly.

World Health Organization

When representatives from around the world met in 1945 to form the United Nations, or UN, one of the items they discussed was the creation of a “global health organization” (WHO, 2010a). Three years later, on 7 April 1948, the UN established the World Health Organization, or WHO. “WHO is the directing and coordinating authority for health within the United Nations system” (WHO, 2010a), similar to a global Department of Health and Human Services. The US and Mexico are each members of both the UN and WHO. The WHO addresses health issues on a global scale and is a valuable source of information on disease outbreaks throughout the world and international plans and legislation.

In 2002, WHO addressed the threat of contaminated food used for bioterrorism resulting in their publication “Terrorist Threats to Food.” WHO revised this publication in May 2008 under the same title. In this, WHO provides guidance to UN members on how to respond to the threat of terrorism using their food supply (WHO, 2008).

WHO believes in “taking sensible precautions, coupled with establishing and strengthening surveillance and response capacity” (WHO, 2008:Executive Summary) to

fight food terrorism. The WHO's plan uses two main strategies: prevention and response. This plan is discussed in this study.

Federal Government

The executive branch of the federal government consists of fifteen executive departments in addition to other independent agencies, boards, commissions, and committees (USA, 2010). These departments and agencies manage specific areas of national and international affairs, enforce federal laws, and otherwise carry out the policies of the President of the US. Therefore, these federal departments and agencies are an important source of information regarding bioterrorism and other associated issues. The following lists and describes several of these organizations.

Department of Homeland Security

President George W. Bush created the Office of Homeland Security eleven days following the terrorist attacks on 11 September 2001. This office was given the responsibility to coordinate and direct a comprehensive national strategy to keep America safe from terrorism and to be able to effectively respond to any future terrorist attack. In the summer of 2002, Congress introduced a bill to establish the Department of Homeland Security, or DHS. The Federal Emergency Management Agency, or FEMA, the Customs Service, the Border Patrol, and the US Coast Guard became part of this new department (Borja, 2008). DHS has the mission of keeping America safe from terrorism, including foodborne bioterrorism attacks, and has oversight over aviation, border security, cyber security, and emergency response (DHS, 2010).

Department of Health and Human Services

The Department of Health and Human Services, or HHS, is the federal government's primary agency for protecting the health of all Americans and for providing important human health services in the event of a national emergency, including a foodborne bioterrorism attack (HHS, 2010a). HHS oversees several important organizations listed and described below.

Centers for Disease Control and Prevention. The Centers for Disease Control and Prevention, or CDC, is an agency within HHS that possesses the expertise, information, and tools to help people protect their health. They promote health and the prevention of disease, injury, and disability, and are instrumental in the preparation for health threats. The CDC monitors health, detects and investigates health issues, conducts research to enhance prevention, develops public health policy, implements prevention strategies, promotes healthy behavior, and provides health leadership and training (CDC, "About CDC", 2010a). The CDC provides information on foodborne bioterrorism agents and diseases on its website and in two of its periodicals. The CDC publishes monthly the peer-reviewed journal *Emerging Infectious Diseases* which is the third most circulated infectious disease journal with 17,000 subscribers in more than 100 countries (CDC, "About *Emerging*", 2010b). The CDC also publishes the *Morbidity and Mortality Weekly Report* (MMWR) which is the CDC's "primary vehicle for scientific publication of timely, reliable, authoritative, accurate, objective, and useful public health information and recommendations" (CDC, "About the", 2010c). The CDC is not a regulatory agency.

Food and Drug Administration. The Food and Drug Administration, or FDA, has the responsibility to protect public health and has regulatory oversight over the

safety and security of human and animal drugs, biological products, medical devices, certain parts of the nation's food supply, and other related activities. The FDA is responsible to advance the use of innovations that make food and medicines safer, more effective, and cheaper. The FDA also provides the public information on food and medicine in an effort to improve public health (FDA, 2010).

National Institutes of Health. The National Institutes of Health, or NIH, is America's medical research agency and the world's largest source of medical research funding. The NIH consists of 27 institutes and centers, each with their own specific research area. The NIH funds more than 300,000 researchers at over 3,000 universities and research institutions with 6,000 scientists of their own (NIH, 2010).

Department of State

The Department of State, or DOS, is the federal government's executive department for international relations and executes the federal government's diplomatic missions abroad while implementing US foreign policy. DOS would interact with a foreign country, such as Mexico, for issues that cross international borders. This interaction includes coordination of foreign aid in the event of a national-level disaster. DOS also determines which nations are listed as State Sponsors of Terrorism and which organizations are categorized as Terrorist Organizations (DOS, 2010a).

Department of Agriculture

The US Department of Agriculture, or USDA, is the federal government's executive department for developing and executing federal government policy relating to farming, agriculture, and food. The USDA also promotes agricultural production and trade and food safety (USDA, 2010a).

Foreign Agricultural Service. The mission of the Foreign Agricultural Service, or FAS, is to gain access of US agricultural products into foreign markets. FAS gathers information on agricultural imports and exports and is a source of information on Mexican agriculture and trade (USDA, 2010b).

Economic Research Service. Within the USDA, the Economic Research Service, or ERS, conducts social science research, including socioeconomic indicators and market analysis. ERS provides the research analysis and results, briefings, and reports to policymakers and their staffs and is a more detailed source for information on US and Mexican agriculture and trade (USDA, 2010b). ERS publishes their economic information, research, and analysis in their magazine *Amber Waves* four times a year (ERS, 2010a).

Department of Defense

The Department of Defense, or DoD, provides the military forces required to fight and win our nation's wars to protect the security and sovereignty of the US (DoD, 2011). The DoD has built the capability to protect servicemembers and expanded that capability to assist the nation. Global Emerging Infections Surveillance and Response Systems (GEIS) Operations contributes to surveillance and detection of, and response to emerging infections. This includes respiratory infections, gastrointestinal infections, febrile illness syndromes, antimicrobial resistance, and sexually transmitted infections (AFHSC, 2011).

US Army Medical Research Institute of Infectious Diseases. The mission of the US Army Medical Research Institute of Infectious Diseases, or USAMRIID, is to research biological threats, leading to medical solutions, to protect soldiers, sailors, airmen, marines, and all other military service members. It is the

primary medical research laboratory for the US Biological Defense Research Program. It is the only laboratory in the DoD that is equipped to safety study hazardous infectious agents that need the maximum containment at biosafety level 4 (USAMARIID, 2010a). USAMRIID supports the CDC and the WHO to investigate emerging diseases and supports HHS, DHS, and other federal agencies to develop medical countermeasures to protect US citizens (USAMARIID, 2010b).

National Response Framework

The National Response Framework, or NRF, outlines how the US responds to disasters and emergencies, including acts of bioterrorism. Included in the document are the guiding principles, roles, and organizational structure that outline how local, state, and the federal governments, private sector, and non-governmental organizations respond. The NRF also covers planning and additional resources an organization may require to be prepared for an emergency response. The NRF is a framework, not a plan, that may be adapted to the specific situation at hand and to the size of the incident. The NRF defines "response" as the "immediate actions to save lives, protect property and the environment, and meet basic human needs" (FEMA, 2008:1). "Response" also includes executing plans and completing actions to help short-term recovery.

New Federal Legislation

The 111th US Congress, serving from 2009 to 2010, passed 28 notable acts of federal legislation, which is substantially more than in recent memory (Library of Congress, 2010). One of these bills being considered at the time of this study is the FDA Food Safety Modernization Act. This Act sets out to improve the safety of the US food supply by providing new powers and resources to the FDA. (Associated Press, 2010;

Library of Congress, 2010). The results of this legislation and its impact were considered in this study.

State of Ohio

Of the fifty states that could have been used for this study, the state of Ohio represents a typical US state and is an adequate example of a state that would receive food from Mexico. Ohio has 11.5 million people, which is not as large as California, Texas, New York, or Florida, each with over 18 million residents, or as small as Montana, Delaware, North and South Dakota, Vermont, or Wyoming, each with less than one million residents (Census, 2010). Ohio consists of 44,825 square miles, which is not as large as the giant states of Texas, California, Montana, New Mexico, Arizona, Nevada, and Colorado, each with over 100,000 square miles, but not as small as Vermont, New Hampshire, New Jersey, Connecticut, Delaware, and Rhode Island, each with less than 10,000 square miles (Wikipedia, 2010). Because of Ohio's location in the Midwest, it is not located next to the Mexican border, nor is it the furthest from, but is somewhere in the middle. Ohio is 84.7% White, 2.8% Hispanic, 12.1% Black, 1.6% Asian, and 0.3% American Indian, which is not dramatically different from the ethnicity of the entire US which is 79.6% White, 15.8% Hispanic, 12.9% Black, 4.6% Asian, and 1.0% American Indian (Census, 2010).

State governments also regulate imported food into their states. The Food Safety Division of Ohio's Department of Agriculture is Ohio's equivalent to the USDA and regulates imported food and provides notices of food recalls. Ohio's Department of Public Safety manages the state's response to a bioterrorism incident by preparing

emergency operations plans, conducting training and emergency exercises, and operating the state's emergency operations center during an incident (State of Ohio, 2010).

Professional Publications and Councils

Many professional publications provided important information contributing to this study. The Massachusetts Medical Society publishes the medical journal *New England Journal of Medicine* which provides medical research and important information in biomedical science and clinical practice (NEJM, 2010). The American Medical Association publishes *The Journal of the American Medical Association* 48 times per year "to promote the science and art of medicine and the betterment of public health" (JAMA, 2010). The Infectious Diseases Society of America publishes the *Journal of Infectious Diseases* that provides "research on the pathogenesis, diagnosis, and treatment of infectious diseases, on the microbes that cause them, and on disorders of host immune mechanisms" (JID, 2010). The Johns Hopkins Bloomberg School of Public Health publishes the *American Journal of Epidemiology* which presents research findings and methodological developments in epidemiological research (*American Journal of Epidemiology*, 2010). The American Academy for Microbiology is a leadership group within the American Society for Microbiology and publishes the journal *mBio* that provides research in microbiology (*mBio*, 2010). The Institute of Medicine is the health organization within the National Academies and is an independent organization that provides medical advice to the government and the public to improve health (Institute of Medicine, 2010). Information from their reports was beneficial and was used in this study.

The Program for Monitoring Emerging Diseases, or ProMED, reports on outbreaks of infectious diseases and acute exposures to toxins, which includes foodborne pathogens. ProMED operates through the internet, thus allowing it to report rapidly and on a global scale to report its information. ProMED uses media reports, official reports, and local observers as sources of information. ProMED email currently reaches over 40,000 subscribers in 185 countries. ProMED has served as an official program for the International Society for Infectious Diseases since 1999 (ProMED, 2009). Data for many of the current foodborne outbreaks came from this source.

II. Literature Review

Introduction

Many areas were required to be covered to answer the question of what should be done to combat biological terrorism from food originating from Mexico. These areas include an understanding of Mexico, the food production process, foodborne pathogens, bioterrorism and its effects, and the response from a global, national, and state level. The following literature review sought out information on these topics.

Mexico

Because the food in question comes from Mexico, a discussion on Mexico, including its government, economy, trade, agriculture, and national security is appropriate. See Figure 2 for a map of Mexico.

Figure 2. Map of Mexico (Bureau of Western Hemispheric Affairs, 2010b)

Geography

The United Mexican States, or Mexico, covers an area of 761,600 square miles, which is less than one fourth the size of the contiguous US. Mexico consists of costal lowlands and central high plateaus with mountain ranges that reach up to over 18,000 feet above sea level. Mexico's climate is desert in the north and tropical in the south (Bureau of Western Hemispheric Affairs, 2010b).

People

Mexico is the most populated Spanish-speaking country in the world with over 111 million people. About three-fourths of the people live in the cities. Many Mexicans are leaving underdeveloped southern states and the crowded central plateau in search of opportunities for employment in the industrialized city centers and the developing areas along the US border. The capitol, Mexico City, is an example of this with a metropolitan population of nearly 22 million, making it the largest city in the western hemisphere. The border cities of Ciudad Juarez and Tijuana have also recently increased in population. Of Mexico's of 45.5 million workforce, 21% are involved in the food production industry: agriculture, forestry, hunting, and fishing. The average Mexican worker earns $13,542 per year (Bureau of Western Hemispheric Affairs, 2010a).

Government

Mexico is a federal republic with 31 states and a federal district. Although Mexico gained its independence from Spain in 1821, its government currently follows the 1917 constitution. Mexico has independent executive, legislative, and judicial branches in its federal government. The executive branch, with power vested in the president, has historically been the dominant branch. The president serves a single six-year term with

no vice president. If the president dies or is removed from office, Congress elects a provisional president. The Congress is comprised of a Senate and a Chamber of Deputies. Senators serve a single six-year term while deputies serve a single three-year term. The judiciary is divided into federal and state court systems. Federal courts have jurisdiction over most civil cases and some major felonies. Trial is by judge and not by jury (Bureau of Western Hemispheric Affairs, 2010a).

Economy and Trade

Mexico is extremely dependent on exporting to the US. These exports are worth more than a quarter of Mexico's $1.088 trillion gross domestic product (GDP), which shrunk by 6.5% in 2009. Mexico keeps its minimum wage, which is around $4.50 per day, low intentionally in part to help control inflation, which is around 4%. Mexico's agriculture market is 4% of GDP and produces corn, wheat, soybeans, rice, beans, coffee, fruit, tomatoes, beef, poultry, and dairy products. About 80% of Mexico's exports in 2009, worth $185 billion, were sent to the US. Mexico is the second-largest (48% of total) export market for the US, worth $112 billion. In 2009, Mexico was the world's seventh-largest producer of crude oil and the second-largest supplier of oil to the US. Revenues from oil and gas provided more than a third of all Mexican government revenues and are the country's largest source of foreign currency (Bureau of Western Hemispheric Affairs, 2010b).

Agriculture

Only 11% of Mexico's land can be used for growing crops, and less than 3% is currently irrigated. Corn, tomatoes, sugar cane, dry beans, and avocados are Mexico's top revenue-producing crops. Beef, poultry, pork, and dairy products also create

significant revenue. Agriculture accounted for 4.3% of Mexico's GDP in 2009; however, agricultural employment made up more than 15% of Mexico's total employment. Due to the North American Free Trade Agreement (NAFTA) Mexico is involved in globalized competition in the agricultural sector with some farmers significantly benefiting from increased access to the world market. Fruit and vegetable exports from Mexico have dramatically increased recently, becoming greater than $4.7 billion to the US alone in 2009. However, farms in Mexico tend to be small with a large subsistence rural population that is not part of the formal economy (Bureau of Western Hemispheric Affairs, 2010a). According to the USDA's FAS, half of Mexico's food producers are subsistence farmers with most of them growing crops or raising livestock on 12 acres or less (FAS, 2010).

For fiscal year 2009, foreign countries supplied nearly seventy-two billion dollars worth of agriculture into the United States. Just behind Canada and the European Union, Mexico supplied over eleven billion dollars worth of agricultural products into the country according to the USDA's ERS (2010b). Most of these products consisted of vegetables ($3 billion), alcohol ($2 billion), and fruits and nuts ($2 billion). Mexico has maintained this significant trade status to the United States for at least the last two decades. See Appendix E for a more detailed breakdown.

Maquiladoras are companies in Mexico that manufacture or process exports, including food, into the US. Because Mexican labor is inexpensive and NAFTA made taxes and custom fees negligible, foreign companies benefit from establishing these maquiladoras. Most of these maquiladoras are owned by the US, Japan, and the European Union. With 80% of Mexican goods shipped to the US, these maquiladoras are

strategically located within a short drive to the US-Mexican border and are fairly common in cities such as Tijuana, Ciudad Juarez, and Matamoros that are directly across the border from San Diego, El Paso, and Brownsville, respectively. More than one million Mexicans work in over 3,000 maquiladora manufacturing or export assembly plants in northern Mexico (Rosenberg, 2007).

National Security

Mexico's 225,000 person military consists of an army, navy, and air force. The military provides national defense, narcotics control, and civic action assignments such as search and rescue and disaster relief. Mexico has a 500,000 person federal, state, and municipal police force, which includes analysts and investigators. At the state and local level, police maintain order and public security but usually do not investigate crimes. In 2009, the Mexican Congress passed legislation increasing the investigative and intelligence capabilities of the Federal Police, which was increased from 20,000 personnel to approximately 32,000. Mexico’s President Calderon has made fighting organized crime a main concern of his administration and has deployed the military to ten states to assist or replace the weak and usually corrupt local and state police. Mexico’s armed forces have demonstrated that they are willing to carry out forceful operations against the drug cartels (Bureau of Western Hemispheric Affairs, 2010b).

Mexico is corrupt. The assumption that most people make of Mexican government officials, judges, and law enforcement is that they are “on the take” from drug cartels. While Mexican history before their independence from Spain was full of corruption (officials appointed by Spain were expected to support themselves from getting their pay from the locals), not much has changed since then. There seems to

always be a shortfall in government revenue to pay for promised services, so corruption, in the form of accepting of bribes or extortion, made up the difference and became a way to pay for government operations (Harms, 1995). It seems that corruption is necessary for Mexico to maintain order and stability. The Spanish phrase “plata o plombo” or “silver or lead,” meaning to accept a bribe (silver) or accept a bullet (lead) is the way of life in Mexico (Bowen, 2001). With organized crime so pervasive in Mexican society, it would be difficult, if not impossible, for public officials or law enforcement officers to escape corruption. This corruption is the largest obstacle for the Mexican government. In this type of environment, the threat of a bioterrorist attack on America’s food supply coming from Mexico is real.

Mexican drug cartels are affecting the inspection process. Due to the violence resulting from the Mexican government’s law enforcement efforts against drug cartels, the USDA has had to change the way they inspect Mexican cattle coming into the US. Mexico imported 940,869 live cattle into the US in 2009 (ERS, 2011b) because many US cattle feedlots depend upon the new cattle that Mexico provides. USDA livestock inspections can prevent infected cattle from entering the American food supply. However, two incidents south of the Texas/Mexico border affected the inspections and hence the trade with Mexico. USDA inspectors travel into Mexico to conduct health inspections on the cattle in “export pens” before the cattle are allowed to enter the US. One USDA inspector was held at gunpoint by a cartel member and another inspector was robbed in another city. The USDA prohibited their inspectors from traveling through these two ports of entry unless the State Department determined that conditions were safe, making inspections a daily decision. The result is that Mexico sends their cattle to

different ports of entry, thus overloading those ports of entry and decreasing trade. Additionally, the USDA has established temporary inspection stations on the US side of the border where the holding pens are smaller and when one head of cattle is rejected, the entire load of cattle is sent back to Mexico (Crosby, 2010).

Food Production Process

The food production process starts at the farm where the raw materials are grown or livestock are raised. The farm may be a fruit or vegetable farm; an orchard with fruit or nut trees; a vineyard with grape vines; a market garden that grows vegetables; a ranch used for raising grazing livestock like cattle, sheep, or other meat-producing animals; a poultry farm with chickens, turkeys, or other fowls raised for their meat or eggs; a dairy farm with milk cows (or goats or other mammals); fish farms with captive fish; fields of grain; or a plantation with sugar cane, coffee, or tobacco.

Once the crops have matured, they are ready to be harvested from the fields. Grain is usually reaped, or cut, using a scythe, sickle, or reaper. Larger farms may use larger and more expensive farm machinery like a combine harvester. While still on the farm, the crops may require drying, sorting, cleaning, and/or packing before being transported elsewhere.

While some produce may be immediately ready for human consumption, most farm products require further processing. These farm products are taken to food processing facilities where they go through sometimes numerous and varied food processes. Added to the food may be water, salt, or a number of other ingredients. The processed food may be frozen or dried, or placed in bottles, cans, boxes, plastic, or bags. Livestock are killed and processed for consumption as food products at slaughterhouses.

Now that the food has been processed, the product is ready to be shipped to market. There was a time when consumers either grew most of their food themselves or bought their food from local producers, usually small-scale farmers. Currently, long-distance shipping is routine and international trade is widespread (Buckley, 2010). Food processors ship their products in individual packages and in bulk containers. They use railroad cars, trucks, boats, and planes for transportation.

The market, or food retailers, mentioned in the previous paragraph consist of many kinds of businesses: grocery stores, restaurants, and food service or catering businesses that serve schools, hospitals, and nursing homes. Other food retailers include convenience stores, health food stores, and even online grocers. This is where we go to buy the food that we will eat.

While food production, harvesting, storage, transportation, and the sale of food might be somewhat similar for many of the same types of food, food preparation at the level of the consumer is extremely diverse. Household appliances such as ovens, stoves, microwaves, grills, deep fryers, broilers, toasters, mixers, blenders, juicers, refrigerators, freezers, pots and pans, food processors, bread machines, waffle irons, and slow cookers, just to name a few, are commonly used every day in our kitchens to prepare the food we eat (Buckley, 2010). See Figure 3 for the food production process.

Agricultural Production → Harvesting → Storage and Transportation → Processing → Storage and Transportation → Wholesale and Retail Distribution → Consumer

Figure 3. Food Production Process (WHO, 2008; Buckley, 2010)

Foodborne Pathogens

Foodborne Diseases

Consuming biologically contaminated food or drinks can cause a foodborne disease. Once in the digestive tract, the microbe can reproduce, produce toxins, and invade other regions of the body. This "incubation" period, lasting from hours to days, may be followed by nausea, diarrhea, and abdominal cramping, depending upon the organism producing the disease (CDC, "Frequently", 2005). The CDC estimates that 47.8 million cases of foodborne disease occur each year in the US resulting in 128,000 hospitalizations and 3,000 deaths (Scallan, et al., 2011; Appendix B).

According to the CDC, the most common foodborne diseases are caused by *Salmonella*, norovirus, *Campylobacter, Toxoplasma*, *E. coli* O157, *Listeria*, and *Clostridium perfringens* (Scallan, et al., 2011; Appendix B). Usually, the foodborne infections are identified after several infected people seek medical care. There are laboratory tests that identify the organism responsible for the illness. Culturing stool samples identify bacteria, while viruses are usually identified by testing stool samples for genetic markers that indicate which virus is present. Many foodborne illnesses remain undiagnosed because the sick person does not seek medical attention or no test is conducted. The CDC estimated that, for every case of salmonellosis that is diagnosed and reported, 38 cases actually occur. Also, for over half of the foodborne outbreaks reported to the CDC, no pathogen can be identified (CDC, "Frequently", 2005).

The CDC reports that local and state health departments investigate between 400 and 500 outbreaks each year (CDC, "Frequently", 2005). Note that an outbreak is

defined as an event "when a group of people consume the same contaminated food and two or more of them come down with the same illness" (CDC, "Frequently", 2005:5).

Survivability

Microorganisms require nutrients and usually a narrow range of environmental conditions to survive. Some survive only within their human hosts. Some need oxygen while some cannot survive in oxygen. Many are destroyed in sunlight and other environmental stressors. Most require a narrow range of temperature, pressure, and pH. Despite all this, some infectious organisms have found a way to make it onto our dinner tables and cause infections. The following are the four pathogens in this study with results of experiments conducted to determine how survivable some of our foodborne pathogens are.

Salmonella. A variety of types of *Salmonella*, especially serotypes Typhimurium and Enteritidis, can survive in a wide range of environments. These include differences in nutrients, pH, temperature, and oxygen, as well as the environmental stressors of osmotic shock and DNA damage (Ngwai, et al., 2007). Salmonella has been shown to not only survive, but to grow, on the surfaces of cut melons, watermelons, and papayas at temperatures as low as 10°C (Golden, et al., 1993; Escartin, et al., 1989).

E. coli. *E. coli* has been shown to be able to survive on cubes of cantaloupes and watermelon down to 5°C when stored for 34 hours and on their rinds under humid conditions for 14-22 days (Del Rossario and Beuchat, 1995). A similar study demonstrated that *E. coli* was able to grow on the surface of strawberries after 24 hours at 23°C and survive at 5°C and -20°C for three days (Yu, et al., 2001).

Listeria. *Listeria monocytogenes* has been shown to survive on chicken breasts that were cooked at one of five different temperatures (150°F, 160°F, 165°F, 170°F, and 180°F) and sealed in plastic for four weeks at 4°C and 10°C (Carpenter and Harrison, 1989). Even after pasteurizing milk at 71.7°C for 15 seconds, the standard for pasteurization, *Listeria monocytogenes* has been shown to survive (Doyle, et al., 1987). Ground beef not cooked to the proper temperature remained contaminated with *Listeria monocytogenes* after refrigeration at 4°C and freezing at -20°C (Novak and Juneja, 2003).

C. botulinum. A pH less than 4.6 has been shown to limit the spore germination, growth, and (most importantly) toxin production for *C. botulinum*. Therefore, acidic conditions have been relied upon to keep this hazard in check. *C. botulinum* spores have been shown to be able to survive in an acidic environment (4.2 pH) for 180 days (Odlaug and Pflug, 1977).

Previous Biological Outbreaks

Contaminated food outbreaks occur naturally every year. This study uses as many outbreaks in the US as could be found. The sources for information on these outbreaks includes the CDC, WHO, ProMED, and state health departments. Appendix F consists of a detailed description of previous biological outbreaks with sources cited. Appendix G summarizes those outbreaks. Note that this list is not exhaustive, but should provide insight into some characteristics of the different foodborne pathogens.

Salmonella, *E. coli*, *Listeria*, and *C. botulinum* were the four most frequent causes of foodborne outbreaks found in this study from 1977 to 2010. This section will provide some observations while a more detailed analysis is conducted in the Results chapter.

Note from Table 1 and Figure 4 that *Salmonella* caused the most outbreaks with 17, while *E. coli* caused the least number with 10.

Table 1. The Four Most Frequent Causes of Foodborne Outbreaks 1977-2010 (Appendix F)

	Salmonella	***E. coli***	***Listeria***	***C. botulinum***	**TOTAL**
Outbreaks	17	10	13	11	51
Deaths	7	5	105	2	119
Infections	245,257	1,269	472	191	247,189

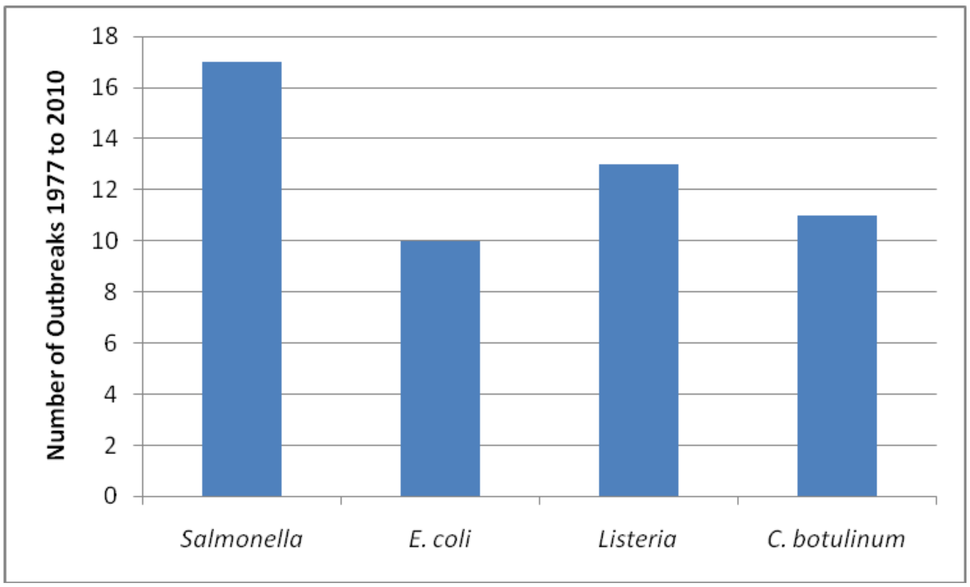

Figure 4. Number of Outbreaks for the Four Most Frequent Causes of Foodborne Outbreaks 1977-2010 (Appendix F)

Also observe from Figure 5 that, by a large margin, *Listeria* caused the most deaths, 105, with relatively fewer infections, 472, than *Salmonella* or *E. coli*, 245,257 and 1,269 respectively.

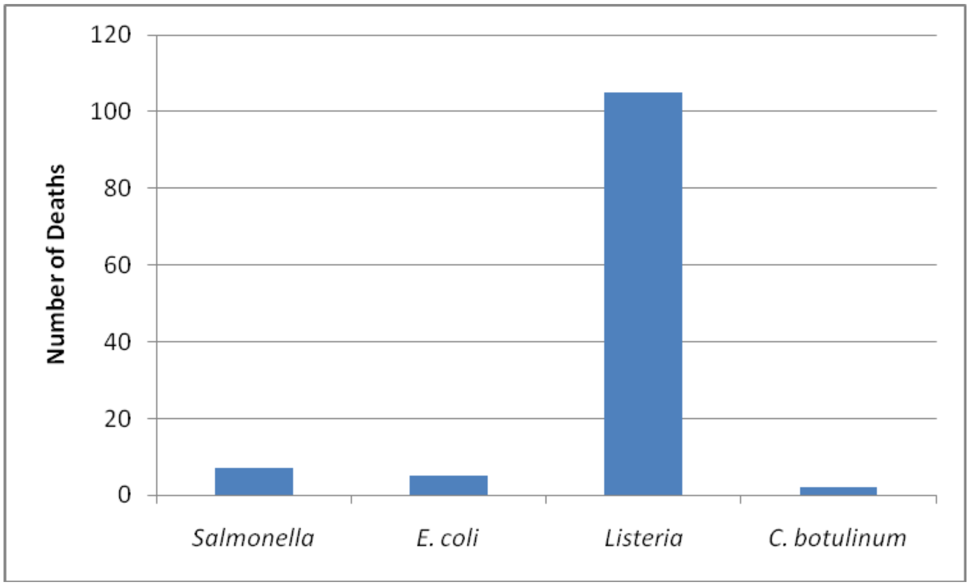

Figure 5. Number of Deaths for the Four Most Frequent Causes of Foodborne Outbreaks 1977-2010 (Appendix F)

By far, *Salmonella* infected the largest number of people, 238,427, as shown by Figure 6. Note that the number of infections is represented by a logarithmic scale, so *Salmonella* is two orders of magnitude, or one-hundred times, that of *E. coli*. *Salmonella* is responsible for the four largest outbreak infections in this study, nine of the ten largest outbreaks, and fourteen of the twenty-one largest outbreaks See Table 2.

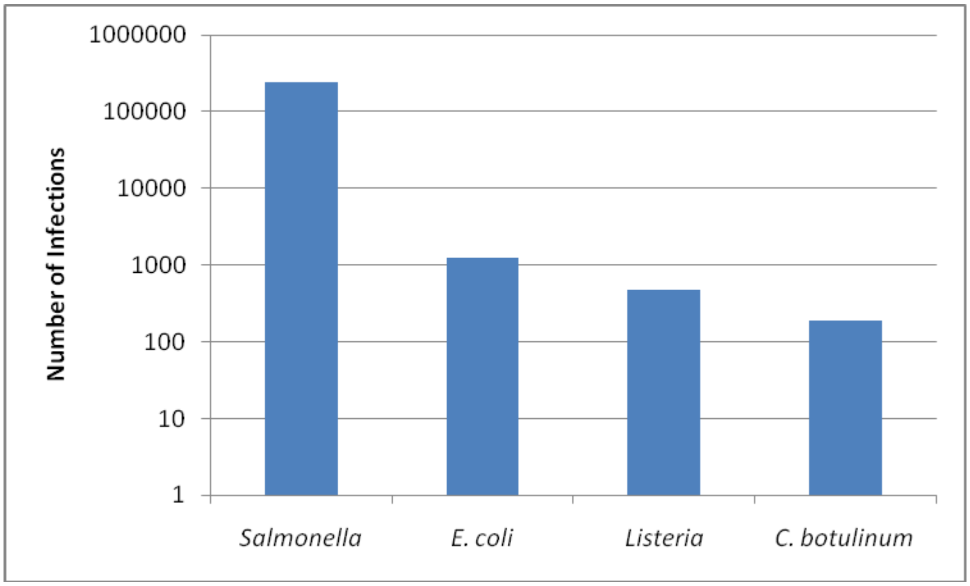

Figure 6. Number of Infections for the Four Most Frequent Causes of Foodborne Outbreaks 1977-2010 (Appendix F)

Table 2. Most Infections from Previous Foodborne Outbreaks

Year	Food	Died	Infected	Pathogen
1994	Ice cream	0	224,000	*Salmonella*
1985	Milk	4	16,284	*Salmonella*
2010	Eggs	0	1,519	*Salmonella*
2008	Salsa	2	1,442	*Salmonella*
1999	Water	2	781	*E. coli*
2010	Ground beef	0	500	*Salmonella*
2006	Peanut butter	0	425	*Salmonella*
2007	Pot pies	0	272	*Salmonella*
2009	Alfalfa sprouts	0	235	*Salmonella*
2006	Tomatoes	0	183	*Salmonella*
2006	Spinach	1	183	*E. coli*
1985	Cheese	48	142	*Listeria*
2010	Bean sprouts	0	106	*Salmonella*
1998	Hot dogs	17	75	*Listeria*
2006	Lettuce	0	71	*E. coli*
2009	Cookie dough	0	65	*E. coli*
2007	Snack food	0	65	*Salmonella*
2010	Duck eggs	1	63	*Salmonella*
2007	Pet food	0	62	*Salmonella*
1977	Hot sauce	0	59	*C. botulinum*
2008	Cantaloupe	0	51	*Salmonella*

Humans can serve as reservoirs for infectious diseases. Mary Mallon, known as the famous "Typhoid Mary," was an Irish emigrant who worked as a cook in the New York City area 1900-1907 and then again 1910-1915. Unknown to her, she was a carrier of the typhoid bacteria despite being healthy herself. While serving as a cook, she spread the bacteria to at least 53 people with three dying of typhoid fever. The New York City Health Department quarantined her twice: 1907-1910 and 1915-1938. An autopsy at her death in 1938 revealed that Mary was still infectious with the live typhoid bacteria and that it was located in her gallbladder (*New York Times*, 1938).

Foodborne Pathogens found in Mexico. Several foodborne pathogens have been identified in Mexico (Hollinger, 1999). The list includes some that are common to the US, including *Salmonella*, *Campylobacter*, and *E. coli*. However, several pathogens are rarely seen in the US and may be considered for use by future terrorists.

Vibrio cholera. The bacteria *Vibrio cholera* causes the disease cholera, which is a severe illness that causes diarrhea, vomiting, and leg cramps. The rapid loss of body fluids could result in severe dehydration, shock, and death in as rapid as several hours, although symptoms usually occur in 2-3 days. Although cholera is common in underdeveloped nations, industrialized countries have been free from cholera for the past century due to developed water treatment systems. Cholera can be found in feces-contaminated water and food. The disease is easily treated. Affected patients should immediately replace loss fluids and salts in the form of an oral rehydration solution or intravenous fluids for severe cases. Antibiotics may also shorten the illness's duration and severity (CDC, "Cholera", 2010j). The CDC reports ("Foodborne Outbreak", 2011a) that bottled water without broken seals and bottled or canned carbonated drinks are safe

for use. This may apply only to natural outbreaks and not deliberate acts of terrorism. Because 100 million cholera bacteria are required for a healthy adult to become infected (MedicineNet, 2011), terrorists would require a large quantity of *V. cholerae* to infect a large number of Americans in the US.

Salmonella Typhi. While typhoid fever is a common infection in underdeveloped nations, affecting about 21.5 million people annually, there are only about 400 typhoid fever infections in the US each year caused by *Salmonella* Typhi bacteria. About 300 of these people are infected outside of the US. *Salmonella* Typhi infects people through food and drink contaminated from tainted water or contaminated people. Symptoms include a high fever, weakness, stomach pain, headache, and loss of appetite. There is a vaccine against *Salmonella* Typhi, but, if infected, patients may be treated with antibiotics. While treated patients rarely die, up to one in five infected people may die if untreated (CDC, "Typhoid Fever," 2010k).

Brucella. Brucellosis has been in Mexico since the beginning of the 1900s and is endemic with the disease (Luna-Martinez and Mejia-Teran, 2002). Mexico has averaged more than 2,000 brucellosis infections and almost 20 deaths annually (Pacheco and Luna-Martinez, 1999). People are infected by consuming unpasteurized milk and milk products such as cheese. As much as 35% of Mexican cow's milk and 85% of goat milk is unpasteurized with no sanitary surveillance (Luna-Martinez, 1999). In the US, there are only 100 to 200 infections annually because we pasteurize our milk which kills the *Brucella* bacteria (CDC, "Brucellosis", 2007b)

Bioterrorism

Goals of Terrorism

People and organizations conduct terrorist acts to attain or get closer to their objectives, whether that is to establish a more desirable government, destroy a hated population of people, repel enemy forces, increase a country's land and people, or to stop the destructive acts of others. Terrorists further their objectives by creating fear; provoking overreaction by their enemies; widening a conflict; obtaining recognition for their cause; gaining media attention; embarrassing, harassing, or weakening government; gaining or destroying capital or property; influencing government decisions; freeing prisoners; or satisfying vengeance (International Terrorism and Security Research, 2010).

Previous Bioterrorist Attacks

By understanding how terrorists have used biological agents in the past, perhaps we can anticipate how they will use them in the future and be able to adequately counteract their bioterrorism.

Over 2,000 years ago, armies poisoned water supplies and the tips of arrows in the earliest examples of biological warfare. Medieval times saw armies catapulting infected dead bodies over besieged city walls. Japan and their Unit 731 used biological weapons against the Chinese during the late 1930s and early 1940s.

While there have been many more unsuccessful attempts at bioterrorism, the following are events in the US that biological agents were used and reached their intended targets or destinations.

The 1984 Rajneeshee *Salmonella* Attacks. Bhagwan Shree Rajneesh and thousands of his followers moved to northern Oregon and desired to politically control

that area, starting with Wasco County. Because they did not have enough voting members for their own candidates to win an election, they decided to use the *Salmonella* bacteria to keep county members from voting. On 29 August 1984, followers of Rajneesh poisoned two county commissioners with glasses of water containing *Salmonella* bacteria. Both men became sick with one being hospitalized. A subsequent attempt to contaminate doorknobs, urinal handles, and produce markets failed. Finally, in September and October 1984, they spread *Salmonella* bacteria on the salad bars of ten local restaurants. The salmonella infected 751 people who developed acute gastroenteritis. The hospital treated 45 victims with no deaths. Only one of the ten affected restaurants financially survived. Two followers of Rajneesh each served 29 months in jail. This incident was the first and largest bioterrorism attack in America (Rothwell, 2004).

The 1996 *Shigella dysenteria* Contamination. On 29 October 1996, a disgruntled former laboratory employee in Dallas, Texas, deliberately contaminated pastries placed in the staff break room with *Shigella dysenteria* type 2 from the laboratory's stock strain. Twelve laboratory staff developed severe acute diarrheal illness with four being hospitalized (WHO, 2008; Kolavic, et al., 1997).

The 2001 Anthrax Attacks. The 2001 anthrax attacks immediately followed the September 11 attacks and came in two waves. A total of seven letters are believed to have been used. The first five letters, postmarked 18 September 2001, were mailed to four New York City news organizations and a newspaper in Florida. The letters contained anthrax that appeared to be brown and granular. The last two letters,

postmarked 9 October, were sent to senators and opened on 15 October and 16 November. These letters contained a more refined powdery anthrax. The contaminated letters infected at least 22 victims and five of those died. Several contaminated buildings were decontaminated by fumigation and chlorine dioxide gas at a reported cost of over one billion dollars. Federal prosecutors declared that a Dr. Ivins, a scientist working at Fort Detrick, Maryland, was the sole author of the anthrax letters (Warrick, 2010).

The 2003 Ricin Letters. On 15 October 2003, a mail-sorting facility located in Greenville, South Carolina, received a package containing a letter and a small metal vial containing ricin powder. On 6 November, the White House mail-processing center in Washington, D.C., received a nearly identical letter addressed to the White House. This letter also contained a small vial containing a white powdery substance later identified as ricin. Both letters were written by “Fallen Angel” and threatened ricin attacks if recently-approved federal trucking regulations became effective. On 2 February 2004, ricin powder was found on a mail sorting machine in the Dirksen Senate Office Building in Washington, D.C. Although there was no vial or letter with the ricin, this contamination is possibly related to the previous two letters. Fortunately, these incidents caused no injuries, but “Fallen Angel” was never found (CDC, “Investigation of a Ricin”, 2003a; FBI, 2004).

Threats of bioterrorism are not all in the past. One of the foreign terrorist organizations (see Appendix D) is Al Qaeda in the Arabian Peninsula, or AQAP. Fox News reported that AQAP wants to attack the US food supplies (Levine, 2010). The source providing the information indicated that AQAP would target food, perhaps salad bars and buffets, at hotels and restaurants within the US. This is the same organization

that tried to detonate explosives-laden underwear over Detroit on 25 December 2009 and sent two explosives-laden packages from Yemen to the US in October 2010.

Why Use Biological Agents?

Morris (2007) gave three reasons why terrorists might prefer to use a biological agent instead of a radioactive dispersal device, or dirty bomb. First, it would be easier to obtain, develop, transport, and deploy a biological agent than radioactive waste (Morris, 2007; Congress, 1999). Biological pathogens are abundant and easily obtained and grown while radioactive material is rare and must be found, protected, and shielded and cannot be grown. In fact, the amount of radiological material continues to decrease over time. Biological pathogens can easily fit into a small glass container while radioactive material must be shielded to avoid detection or harming those people not the intended target. Biological pathogens can be easily placed in food, while radiological material used as a radioactive dispersal device must have explosives and reach their intended targets, usually by inhalation.

Second, biological agents could be obtained and reproduced in small quantities that would be hard to detect and therefore reducing the risk of detection and apprehension before executing the attack. Third, people would be soft targets because of the difficulty in protecting them from the food that they require (Morris, 2007; Congress, 1999).

In a report on the 1984 Rajneeshee *Salmonella* attacks, Thomas Rothwell of the Center for Army Analysis stated that “by choosing the appropriate agent, production of large quantities of bacteria is inexpensive and involves simple equipment and skills. Terrorist groups do not need highly trained technicians or numerous and expensive pieces

of scientific equipment in order to obtain enough deadly pathogen necessary to carry out their attacks" (Rothwell, 2004).

Availability of Foodborne Pathogens in Mexico. Many of the foodborne pathogens are easily obtained naturally, as evidenced by the extent that people in the food production process take to avoid the pathogens (and some still make it through). *Salmonella* can be found in eggs, meat, poultry, milk, and produce. In fact, a 2005 investigation revealed in a sampling of US food that 5.7% of all meat and 33% of poultry tested positive for *Salmonella* (Heymann, 2008). *E. coli* can be found in beef, produce, milk, and contaminated water. *Listeria monocytogenes* is found in milk, cheese, vegetables, and ready-to-eat meats (hot dogs, etc.). *C. botulinum* can be found in home-canned vegetables and fruits that have been improperly heated or preserved (Heymann, 2008). These and many others can be found in contaminated water and food and cultured by terrorists with as little as a university degree in microbiology or other related field.

Biological agents are abundantly available. Pathogenic microbiological agents can be found in clinical and other laboratories, including laboratories involved in food control. Even college chemistry or microbiology often provides sufficient knowledge to produce adequate amounts of a variety of biological agents (WHO, 2008). Foodborne pathogens are readily available in Mexico.

Foodborne Outbreak Versus Bioterrorist Attack

Aum Shinrikyo is the cult responsible for the 20 March 1995 sarin attack on the Tokyo subway system killing 12 commuters. What sometimes goes unmentioned is their bioterroist attacks previous to their use of sarin. Aum Shinrikyo experimented with botulin toxin, anthrax, cholera, Q fever and Ebola virus. They attempted four biological

attacks from April 1990 to March 1995. Attacks included botulin toxin and anthrax spores. No injuries resulted from any of these attacks (Olson, 1999). The year following their sarin attack, about 8,000 children in Sakai City, Japan, became infected by *E. coli* from eating contaminated radish sprouts in their school lunches. Some of the children died (WHO, 2008; Mermin and Griffin, 1999). Natural outbreaks can usually be more devastating than man's acts of bioterrorism. See Tables 3 and 4 for comparisons between biological outbreaks and bioterrorism.

Table 3. Comparison of Most Infections from Previous Foodborne Outbreaks and from Bioterrorist Attacks

Year	Food	Died	Infected	Pathogen
1994	Ice cream	0	224,000	*Salmonella*
1985	Milk	4	16,284	*Salmonella*
2010	Eggs	0	1,519	*Salmonella*
2008	Salsa	2	1,442	*Salmonella*
1999	Water	2	781	*E. coli*
1984	**BIOTERRORIST**	**0**	**751**	***Samonella***
2010	Ground beef	0	500	*Salmonella*
2006	Peanut butter	0	425	*Salmonella*
2007	Pot pies	0	272	*Salmonella*
2009	Alfalfa sprouts	0	235	*Salmonella*
2006	Tomatoes	0	183	*Salmonella*
2006	Spinach	1	183	*E. coli*
1985	Cheese	48	142	*Listeria*
2010	Bean sprouts	0	106	*Salmonella*
1998	Hot dogs	17	75	*Listeria*
2006	Lettuce	0	71	*E. coli*
2009	Cookie dough	0	65	*E. coli*
2007	Snack food	0	65	*Salmonella*
2010	Duck eggs	1	63	*Salmonella*
2007	Pet food	0	62	*Salmonella*
1977	Hot sauce	0	59	*C. botulinum*
2008	Cantaloupe	0	51	*Salmonella*

Table 4. Comparison of Most Deaths from Previous Foodborne Outbreaks and from Bioterrorist Attacks

Year	Food	Died	Infected	Pathogen
1985	Cheese	48	142	*Listeria*
1998	Hot dogs	17	75	*Listeria*
1986	Unknown	16	36	*Listeria*
2002	Turkey	7	46	*Listeria*
2001	**BIOTERRORIST**	**5**	**22**	***B. anthracis***
2010	Celery	5	10	*Listeria*
1985	Milk	4	16,284	*Salmonella*
1983	Milk	4	49	*Listeria*
2000	Turkey	4	21	*Listeria*
2007	Milk	3	5	*Listeria*
2008	Salsa	2	1,442	*Salmonella*
1999	Water	2	781	*E. coli*
1978	At Restaurant	2	34	*C. botulinum*
2009	Ground beef	2	26	*E. coli*
2006	Spinach	1	183	*E. coli*
2010	Duck eggs	1	63	*Salmonella*
1989	Shrimp	1	10	*Listeria*

Effects

A bioterrorism attack could affect many key areas to US interests to include psychological (fear of additional attacks and panic), financial (billions of dollars lost from the attack and to restore, prevent another attack, losses in trade, etc.), government (loss of trust), and state's rights (control of the National Guard, state border control) (Morris, 2007).

Illness, Disease, and Death

The potential hazardous agents that could be used in food terrorism have the potential to cause immediate death, illness, or injury. For example, 48 people in California died with 142 infected with *Listeria monocytogenes* from eating Mexican-style cheese in 1985 (California, 2010; CDC, "Epidemiologic Notes and Reports Listeriosis",

1985a). These biological agents could also cause long-term health effects, such as cancer and birth defects (WHO, 2008). WHO refers to the 1988 outbreak in Shanghai, China, when it states that “if the unintentional contamination of one food, such as clams, can infect 300,000 individuals with a serious debilitating disease, then a concerted, deliberate attack could be devastating, especially if a more dangerous agent was used” (WHO, 2008:7). However, the bioterrorist attack that killed the most people, the 2001 anthrax letters, only killed five while hospitalizing seventeen (Morris, 2007; Hope, 2004).

Economic and Trade Devastation

A terrorist may target a manufactured product, a manufacturing company, an industry, or an entire nation in an attempt to disrupt or destroy an economy. For example, the WHO cites the example of bioterrorists contaminating Israeli exported citrus fruit in 1978, resulting in significant disruption of Israeli trade with several European countries (WHO, 2008). Grapes from Chile were recalled from North American markets in 1989 when the grapes were contaminated with cyanide, resulting in reluctance of consumers to buy any fruit from Chile and costing several hundred million dollars in lost trade export. More than a hundred companies lost their business (WHO, 2008; Root-Bernstein, 1991). The best example is the bovine spongiform encephalopathy outbreak, also known as Mad Cow Disease, in England, where 4.5 million cattle were destroyed in an effort to stop the spread of spongiform encephalitis, resulting in a loss of billions of dollars in European agricultural trade (Sustainable Table, 2010). In 2003, a single cow that tested positive for Mad Cow Disease in Washington State caused the closure or restriction of the US beef markets in Canada, Mexico, South

Korea, Japan, and other countries, resulting in an $11 billion loss to the US beef industry between 2004 and 2007 (Doering, 2008; Morris, 2007; Presley, 2004).

Reduce Food Supply

A bioterrorist attack might cause a mass disruption of the food supply and limit food availability and destroy the area's long term financial market (Morris, 2007; Hope, 2004).

Overwhelming Public Health Services

Upon the outbreak of a foodborne outbreak, whether natural or the result of a bioterrorist attack, hospitals and clinics would likely become flooded with not only the sick, but also those who feel that they might be affected, also known as the "worried well." For example, when terrorists attacked commuters on the Tokyo subway system with sarin nerve gas in 1995, only 12 people died. However, 5,000 people sought medical care. The emergency response to the attack was rapid and substantial with 131 ambulances, 1,364 emergency medical technicians, and 688 patients transported to the hospitals. Beyond this, more than 4,000 people made their own way to hospitals (Okumura, 1998). With hospitals operating near capacity, such a surge would overwhelm public health services and could cause confusion and a slowing of service.

Political and Social Implications

Even a small dissemination of a biological agent resulting in only few casualties can result in significant disruption and much public apprehension. The anthrax letter attack consisted of only five to seven letters infecting only twenty-two people with five deaths (Sobel, et al., 2002). However, the attacks resulted in increases in government funding for biological warfare research, planning, and preparedness. The National

Institute of Allergy and Infectious Diseases' budget increased by $1.5 billion in 2003 and the Project BioShield Act, for purchasing new vaccines and medications, was funded with $5.6 billion during a ten year period starting in 2004 (White House, 2004). In the event of a bioterrorist attack, Americans may doubt that the government is able to protect American citizens from terrorism.

National Planning Scenario 13 (Biological Attack – Food Contamination)

FEMA (2005a) developed National Planning Scenario 13 (Biological Attack – Food Contamination) to determine the results from a scenario of ground beef contaminated with anthrax and distributed to three cities throughout the nation. FEMA calculated that there would be 1,800 people infected with 650 people hospitalized and 500 deaths. The production facilities and distribution plants suffered significant disruption and downtime due to decontamination. The ground beef industry was significantly affected with service disruption. Other food industries were also affected, but to a smaller scale. There was a significant direct financial impact on the meat industry with long-term effects (FEMA, 2005b).

Timeline

National Planning Scenario 13 includes a timeline of when events would be expected to occur. See Table 5 below.

Table 5. Timeline for a Biological Attack (FEMA, 2005b)

Day	Event
1	The biological agent is mixed with the food and is shipped.
3	The first infected victims visit hospital emergency rooms.
3-13	There is a significant influx of infected victims visiting hospital emergency rooms with thousands of mass casualties.
6	Health departments, the CDC, the FDA, and the USDA begin conducting epidemiological investigations.
28	A contaminated product trace is made to the contaminated food production facility. Decontamination commences at the facility.
34	Hospitals report no new cases of illness.

Sandia National Laboratories (JASON, 2003) provides the following timeline for a bioterrorism attack in Figure 7. There is about a three-day delay after infection for symptoms to appear followed by weeks of sick victims.

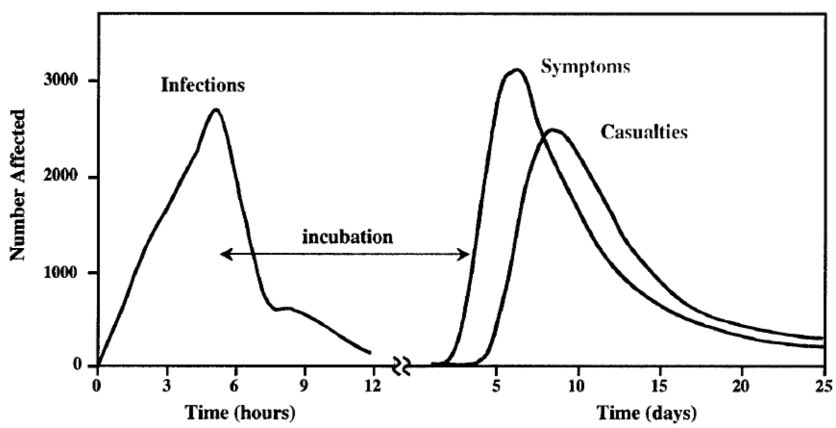

Figure 7. Nominal Timeline for a Bioterrorism Attack (JASON, 2003)

Our Response

"Concern for food safety is a privilege of the wealthy" (Buckley, 2010:28).

Identification and Foodborne Illness Surveillance and Investigation

Why identification is important. The most important part of an investigation of a suspected foodborne outbreak is the identification. To allow for the quick treatment of exposed people and the removal of the contaminated food products from access to the consumer, the biological agent causing the illnesses must be identified as well as what food products are contaminated and by what method the biological agent is reaching the consumer (WHO, 2008).

Identification is difficult. Unprocessed agricultural products grown on small farms are often combined with the products from other farms to create larger shipments. These shipments are often distributed over large geographical areas, sometimes over the world. As a consequence, it is difficult, in some cases, to positively identify the actual manufacturer of an infected shipment (WHO, 2008).

Because contamination often occurs infrequently and not at levels high enough for detection, regular sampling may not be enough to identify a bioterrorist attack. Routine food testing will detect only persistent or widespread contamination and smaller incidents will remain overlooked. Additionally, testing the final product cannot readily identify where along the food production chain the contamination occurred. Therefore, more frequent testing earlier in the food production process may need to be conducted (Buckley, 2010).

Whether the desired outcome is to reduce the effects of a bioterrorism attack or a natural foodborne outbreak, preventive actions must be taken quickly. However, the type of information essential to reduce infections and deaths moves at a snail's pace, if at all,

from the doctor's office or hospital to the local health department and to some type of tracking system.

How we identify. While local and state health or agriculture departments investigate smaller outbreaks of foodborne disease (Buckley, 2010), larger outbreaks require assistance from resources provided by the federal government. These federally-coordinated networks include PulseNet, FoodNet, OutbreakNet, and ESSENCE.

PulseNet. The CDC coordinates a program called PulseNet, which is a national network of public health and food regulatory agency laboratories. The network is comprised of and receives input from state and local health departments and federal agencies such as the USDA's Food Safety and Inspection Service (FSIS) and Animal and Plant Health Inspection Service (APHIS), and the Department of Health and Human Services' (HHS) FDA and CDC. Using the bacteria from infected patients or contaminated food, these PulseNet participants perform molecular subtyping, or "fingerprinting", of the pathogenic bacteria at the DNA level. These laboratories electronically submit these "fingerprints" to the CDC's database for comparison with known strains of organisms. The information collected on the database is available on-demand to any of the participating laboratories for rapid comparison and identification for tracking outbreaks. PulseNet allows outbreak detection even in the case of widely dispersed individual infections (Buckley, 2010; CDC, "PulseNet", 2009b). For example, PulseNet detected the 2002 Western States *E. coli* outbreak in 18 days, resulting in 34 illnesses and no deaths. A similar *E. coli* outbreak in 1993, before PulseNet was used, required 39 days for detection, resulting in 726 illnesses and 4 deaths. The more rapid

detection led to a faster product recall and helped to prevent additional illnesses and deaths (Institute of Medicine, 2008).

FoodNet. The Foodborne Diseases Active Surveillance Network, or FoodNet, is a collective surveillance effort supported by the CDC, FDA, USDA, and ten sites scattered throughout the US. It is not intended to serve as an outbreak investigation system but instead focuses on characterizing the total effects of the foodborne disease by active surveillance and associated epidemiological studies designed to assist public health managers better understand the patterns of the foodborne disease (Buckley 2010; CDC, "FoodNet", 2010e).

OutbreakNet. OutbreakNet is a CDC-led national network of epidemiologists and public health officials who investigate outbreaks of foodborne, waterborne, and other enteric illnesses in the US. Members include all state and local health departments, the USDA, the FDA, and PulseNet. The goal for OutbreakNet is to ensure quick and coordinated detection and response to multi-state outbreaks of enteric diseases and to improve outbreak surveillance (CDC, "OutbreakNet", 2010g).

Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE). ESSENCE looks for similar illnesses, their locations, and the time of their occurrence to provide the earliest possible warning of a biological outbreak or attack. Data originates from emergency rooms, private practice billing codes, work and school absenteeism, and medication usage (Lombardo, et al., 2003).

World Health Organization Plan

As stated in the Literature Review, the WHO believes in "taking sensible precautions, coupled with establishing and strengthening surveillance and response

capacity" (WHO, 2008:Executive Summary) to fight food terrorism. The WHO's plan uses two main strategies: prevention and response.

Prevention. WHO defines prevention of food terrorism as "preventing the sabotage of food during production, processing, distribution and preparation" (WHO, 2008:12). As with many systems developed, prevention is always the first line of defense and is preferred over response options. WHO believes that "the keys to preventing food terrorism are establishing and enhancing food safety management programmes and implementing reasonable security measures" (WHO, 2008:Executive Summary). Prevention is made more difficult by the global food market and the wide diversity of food sources.

Both the food industry and the government are involved and share responsibility in keeping our food safe. WHO also believes that cooperation between government and industry best realizes prevention because the most important way to decrease food risks remain with the food industry itself. Among WHO beliefs are that the food industry owns the responsibility for reducing the likelihood of deliberate contamination of food, starting with the raw materials all the way to distribution of the product, because these companies own and often protect their sometimes unique production methods. WHO believes that, instead of creating new programs, food safety management programs should be strengthened through systems that already exist (WHO, 2008).

The food industry should be supported by government in strengthening existing food safety management systems. This includes the prevention of deliberate contamination. Governments should also promote preventive food safety by using

voluntary and regulatory controls. National policies and resources to support the food industry infrastructure need to be prepared and food legislation, food monitoring, food surveillance, food inspection, foodborne disease surveillance, education, and training need to be satisfactory and current (WHO, 2008).

In an effort to prevent deliberate contamination in the food industry, WHO recommends increasing the security of people and premises, developing security and response plans, safeguarding sources of raw materials and storage facilities and transportation, and controlling and documenting access to critical areas. During the production and harvesting of agricultural products, WHO recommends certain security measures such as tamper-resistant or tamper-evident systems, controlling access to critical control points like the point of introduction of raw materials into the processing stream and open-air drying, and sampling and analysis of certain completed products. During the processing and manufacturing phases in the food production chain, WHO identifies the slaughterhouse, the water used in food processing, and air systems as being vulnerable and recommends protection and inspection of these facilities (WHO, 2008).

WHO recommends fences, locks, on-site security personnel, and alarms to safeguard food during its storage and transportation to market. Because pre-packaged and bulk foods are vulnerable, WHO recommends more secure containers for these items. Additionally, wholesalers and retailers should use reliable suppliers and avoid unusually low priced food. Even those foods that have arrived safely in restaurants are vulnerable to deliberate contamination. WHO recommends that restaurants monitor their condiments in open containers and salad bars for contamination. WHO also cautions that

vending machines are vulnerable. WHO also recommends reducing access to biological organisms that can be used in bioterrorism (WHO, 2008).

WHO acknowledges that, in some cases where food products from small farms are combined and individual identification of the source is lost, it is difficult to trace and recall contaminated products from the market. However, these tracing and market recall mechanisms must work quickly and accurately to protect people before the exposure becomes widespread (WHO, 2008).

Surveillance, preparedness, and response. Sometimes prevention does not work. Even if prevention proved to be entirely adequate, there would still be hoaxes which would have to be addressed as if they were real. The WHO breaks down their response strategy into three parts: surveillance, preparedness, and response (WHO, 2008).

Surveillance. Before a response to bioterrorism can be executed, the act must first be detected. The detection system must be rapid and sensitive enough to identify small clusters of illnesses. WHO recommends that existing foodborne disease surveillance systems be improved and recommends that clinicians, laboratories, and public health officers work closely for early disease detection. WHO also encourages monitoring of school or workplace absenteeism and unusually high demands for certain medication that might indicate a bioterrorism attack, such as drugs that are effective against nausea, vomiting, and diarrhea (WHO, 2008).

Preparedness**.** WHO believes that preparedness includes the following: participants who would be involved in a bioterrorism response knowing their roles and responsibilities and being trained and evaluated on their performance, surveillance

systems in place and able to detect a bioterrorism attack, planning and exercises to test the effectiveness of the plans, vulnerability assessments, ability to investigate and confirm an incident, and effective communication between the applicable government agencies and other organizations that are involved with the bioterrorist attack (WHO, 2008).

Response. WHO defines response as “all measures to identify, contain and minimize the impact of a food terrorist incident” (WHO, 2008:11). WHO believes that the “response to food terrorism depends on awareness of the possibility of a terrorist act and recognition of the incident as involving food” (WHO, 2008:26). WHO points out that an essential part of a bioterrorism response is the identification, tracking, and recall of contaminated food and stresses that, because the goal of the terrorists might be to cause people to become afraid and panic, the government and the industry need to be able to communicate timely and well with the people. Also, the ability to communicate well could even dissuade terrorists from conducting attacks (WHO, 2008).

International Legislation. There are several international agreements that affect how we would respond to a foodborne bioterrorist attack from food imported from Mexico into the US. These include the Codex Alimentarius, the Sanitary and Phytosanitary Measures (SPS), the Technical Barriers to Trade (TBT), and the North American Free Trade Agreement (NAFTA).

In 1963, the United Nations’ (UN’s) Food and Agriculture Organization (FAO) and WHO created the Codex Alimentarius Commission in an effort “to develop food standards, guidelines and related texts such as codes of practice” with the purpose of “protecting health of the consumers and ensuring fair trade practices in the food trade,

and promoting coordination of all food standards work undertaken by international governmental and non-governmental organizations" (WHO, 2010b). The World Trade Organization recognizes the Codex Alimentarius as an international reference point to resolve food safety and consumer protection disputes. Besides covering food labeling, food additives, contaminants, pesticides, risk assessment, and food hygiene, the Codex Alimentarius also covers methods of analysis and sampling along with import and export inspection and certification.

Two international agreements came from the Codex Alimentarius. The SPS Agreement, which became effective in 1995, allows the World Trade Organization (WTO) to limit the policies of its members relating to food safety, including bacterial contaminants, labeling, and inspection in an effort to restrict trade as little as possible. The SPS does not allow national quarantine policies to be used as a technical trade barrier to limit foreign imports. Additionally, the SPS requires a country to scientifically demonstrate that a food is dangerous before it can be regulated. Both of these limitations could prevent the US from acting quickly to respond to a bioterrorist threat (Buckley 2010; WTO, 2010).

The TBT Agreement is closely linked to the SPS with both going into effect in 1995 and having similar goals. The WTO produced the TBT in an effort to make sure that technical regulations, standards, testing, and certification procedures would not create unnecessary obstacles to limit world trade. The TBT prohibits the creation and enforcement of technical requirements for the sole purpose of limiting imports. In accordance with the TBT, the WTO's most-favored-nation rule binds countries' technical requirements, meaning in our case that the US may not subject

Mexico to higher tariffs or lower import quotas, for example, than any other country with most-favored-nation status, like Canada. Also, the TBT encourages countries to recognize the results of other countries' conformity assessment tests, which are the tests that determine if a product conforms to an agreed on standard. The goal is to have international standards (WTO, 2010).

NAFTA is an agreement between Canada, Mexico, and the US designed to eliminate all barriers of trade and investment between the three countries. Upon its implementation on 1 January 1994, NAFTA immediately eliminated most trade tariffs from US imports from Mexico. Those tariffs that were not immediately eliminated were scheduled to be phased in to include all tariffs. Within ten years, all tariffs were eliminated with the exception of US exports to Mexico of corn, dry edible beans, nonfat dry milk, and high fructose corn syrup and Mexican exports to the US of sugar and certain horticultural products. On 1 January 2008, the final provisions of NAFTA were fully implemented (FAS, 2008).

US Government Plan

National Response Framework. The National Response Framework, or NRF, outlines how the US responds to disasters and emergencies, including acts of bioterrorism (FEMA, 2008). The NRF consists of a core document with Emergency Support Function Annexes, Support Annexes, Incident Annexes, and Partner Guides. “Emergency Support Function (ESF) Annexes” gather national capabilities and resources into areas which serve the same function. For example, ESF #11 is Agriculture and Natural Resources, which is what would be used in the incidence of foodborne bioterrorism.

"Support Annexes" explain important supporting characteristics that are applicable to all incidents. During an emergency, many administrative functions and procedures are necessary to ensure effective and efficient incident management. These include critical infrastructure and key resources, financial management, international coordination, private-sector coordination, public affairs, tribal relations, volunteer and donations management, and worker safety and health (FEMA, 2008).

The "Incident Annexes" cover the unique characteristics of the response to seven incident categories. The three Incident Annexes that are used in a foodborne bioterrorism incident are the Biological Incident Annex, the Food and Agriculture Incident Annex, and the Terrorism Incident Law Enforcement and Investigation Incident Annex (FEMA, 2008).

"Partner Guides" are four guides that provide federal, state, local, and private-sector responders a ready reference to the areas covered by the NRF and its supporting annexes. For example, local emergency managers can use the Local Government Partner Guide to find their roles and responsibilities during an incident and that page 16 of the NRF provides more information (FEMA, 2008).

For each annex, the NRF designates a "coordinating agency" that implements the actions contained in the annex. The agencies selected as the coordinating agencies are those that can provide the leadership and expertise specific to that function or incident. For example, the USDA would be the coordinating agency for a food and agriculture incident. "Cooperating agencies" are those that have specific capabilities and knowledge that can assist the coordinating agency. For example, the Department of

Health and Human Services (HHS) might be a cooperating agency in the food and agriculture incident if it affected the health of humans (FEMA, 2008).

Response. State and local governments are primarily responsible to detect the outbreak and to implement actions to mitigate the consequences of the attack. The outbreak is usually first recognized when there is a significantly increased number of people that become sick and are admitted to hospital emergency rooms. Sometimes, routine laboratory surveillance or inspections may first detect the foodborne pathogen. Initially, the foodborne bioterrorist attack may be impossible to differentiate from a naturally occurring biological outbreak and may take many days until it is identified. Laboratories identify, confirm, and characterize the biological agent to make sure that the appropriate medical interventions are used in a timely manner (FEMA, 2008).

Upon the determination by the Secretary of the Department of Homeland Security (DHS) that there is reason to believe that a bioterrorism incident has taken place requiring a coordinated federal response, he or she would likely activate ESF #8 (Public Health and Medical Services Annex), ESF #11 (Agriculture and Natural Resources Annex), all Support Annexes, and the Biological, Food and Agriculture, and Terrorism Incident and Law Enforcement and Investigation Incident Annexes (FEMA, 2008). While the HHS is the federal government's primary agency for response to a bioterrorist attack, the USDA is the federal government's primary agency for attacks that occur in animals used in the commercial production of food and on food processing/slaughtering facilities under its regulatory jurisdiction. Because the Secretary of DHS is the principal federal official for domestic incident management and is overall responsible for coordinating federal operations in response to a terrorist attack, he would have to

determine whether HHS or USDA serve as the Coordinating Agency. The Department of State, Department of Justice, DHS, and possibly up to 12 others would serve as Cooperating Agencies (FEMA, 2008).

Once HHS has been notified of the outbreak and has determined that it is a bioterrorism incident, it notifies the appropriate agencies and convenes a meeting of those belonging to ESF #8 (Public Health and Medical Services Annex) to assess the situation and determine the correct medical actions. DHS coordinates overall federal support that is not medical with the DHS Office of Public Affairs coordinating all federal public announcements and press releases. The Department of State communicates with international organizations, such as the WHO, and coordinates all foreign assistance (FEMA, 2008).

HHS assists state and local public health and medical authorities and provides surveillance recommendations. Starting at the local level and expanding as needed, the public health system protects the population from further effects of the outbreak. The agencies work together to determine the source of the foodborne pathogen and how it was spread, determine treatment, determine how the attack would affect domestic and international issues, control and contain the spread of the contaminated food, support the impending increase of medical services needs, identify the cause of the illnesses, and prevent the further spread of disease by removing the contaminated food from the public by recall (FEMA, 2008).

Once the USDA has been notified that the outbreak is from a foodborne pathogen, it notifies the appropriate agencies and convenes a meeting of those belonging to ESF #11 (Agriculture and Natural Resources Annex) to help ensure the safety and

security of the commercial food supply. The USDA supports state and local authorities and other federal agencies to ensure that the nation's supply of meat, poultry, and egg products is safe and secure. HHS' FDA has statutory authority over all other food. The USDA's Food Safety and Inspection Service, or FSIS, conducts foodborne disease surveillance and coordinates the tracing, recall, and disposal of contaminated food. USDA also provides inspectors and laboratory services to the affected areas, including food processing plants, to make sure that only safe and wholesome food products enter commerce. FSIS District and Field Offices throughout the country coordinate field response activities with the headquarters at the National Response Coordination Center (FEMA, 2008).

The CDC investigates once an outbreak is strongly suspected (CDC, "Frequently", 2005). They search for other cases of infected people among those who may have been exposed to the same infected food. The outbreak is described by time, place, and person. Investigators interview those sick in an effort to identify the food item causing the sickness. If any of the suspected food item remains, it is tested for infection. The investigators seek to make a statistical association between the infected people and the suspected food. The outbreak ends when the exposure ends. Thomas Rothwell of the Center for Army Analysis agrees that "once an outbreak occurs, the creation of a quality epidemiological investigation team is a key element in determining the factors and mechanisms that contributed to the illness. It is imperative that local officials ask for the appropriate assistance if necessary" (Rothwell, 2004:16). If we understand how the infection is transmitted and where it has been distributed, investigators can work to confine or eliminate the outbreak. The investigation works best when criminal

investigators working for a conviction, intelligence investigators gathering information on a terrorist organization, and health care investigators working to stop the outbreak and treat patients, cooperate.

DHS coordinates with HHS, USDA, and state and local officials concerning public announcements and press releases to make sure that communications with the public are timely, consistent, and accurate. The messages are designed to relieve anxieties, ease needless concerns, and solicit cooperation with needed actions (FEMA, 2008).

Up to this point, the discussion has focused on the medical and agricultural aspects of the bioterrorism attack. There is also the criminal investigation and attribution aspects of the attack which need to work with all other aspects of the bioterrorist incident. The Attorney General acts through the Federal Bureau of Investigation, or FBI, to investigate terrorist acts within the US and to coordinate the activities of other members of the law enforcement community. After taking actions to preserve life, minimizing the risks to health, and preventing the bioterrorist act from being expanded or aggravated, law enforcement and investigative officials seek to apprehend and successfully prosecute the perpetrators of the bioterrorism. Perhaps one of the most important pieces of the criminal investigation is the collection of evidence. The FBI coordinates with the HHS' Laboratory Response Network which tests collected samples for the presence of the biological agent. A law enforcement chain of custody is established and maintained with original samples sent to HHS' CDC. The FBI forms a command post called a Joint Operations Center, or JOC. At the JOC, law enforcement

officials gather information for collection, analysis, dissemination, and storage. The investigative personnel collect and manage investigative information (FEMA, 2008).

New Federal Legislation. On 30 November 2010 the US Senate passed (73 for to 25 against with two abstaining) a bill (S.510: FDA Food Safety Modernization Act) to improve the safety of the US food supply by providing new powers and resources to the FDA. The US House of Representatives passed this act, by the same name under H.R. 2751, by a vote of 215 for and 144 against on 22 December 2010. The President signed the bill into law on 4 January 2011. The $1.4 billion bill will make several changes in food production operations. First, the FDA will be allowed to order a recall of contaminated food instead of the current power to only be able to negotiate with companies to order voluntary recalls. Second, large food producers and manufacturers will be required to register with the FDA and provide them with detailed food safety plans. Third, the FDA will be required to establish new produce safety regulations for those companies providing the highest risk fruits and vegetables. Fourth, there will be stricter standards for imported food. Fifth, there will be more inspections of foreign and domestic food facilities with increased attention on those companies with higher risk profiles. Because the USDA regulates meat, poultry, and processed eggs, this bill will not affect these food items (Associated Press, 2010; Library of Congress, 2010).

A State Plan: The State of Ohio

The purpose of the Ohio Emergency Operations Plan, or EOP, is to ensure “the prompt and efficient deployment of state-level emergency response and recovery resources” (Ohio EMA, 2009:BP-12) in an effort to maintain the health, safety, and welfare of those affected by state-level emergencies. The EOP is aligned with the

National Response Framework in its organization including its 15 Emergency Support Functions, or ESFs. The Ohio Emergency Management Agency, or EMA, coordinates the emergency management activities of all state agencies. Under the EOP, the priorities are first to save lives, then to stabilize the incident, then finally to preserve property. The State of Ohio Emergency Operations Center, or SEOC, is a permanent facility located in the state capitol of Columbus and contains fifty-two work stations that can accommodate one hundred and four emergency response workers. The Executive Director of the SEOC notifies and activates primary and support agencies. The state conducts operations in four phases: mitigation, preparedness, response, and recovery (Ohio EMA, 2009).

State emergency response resources and assistance can be requested by local authorities only after all local resources are exhausted or inadequate. When this occurs, the Governor can declare a state of emergency. This declaration will activate state resources. When the emergency exceeds the capabilities of the state, the Ohio EMA will contact FEMA Region V in Chicago, Illinois, to alert them that the Governor will be submitting a formal request for federal assistance (Ohio EMA, 2009).

In the event of a bioterrorism attack, the state ESFs most likely to be activated are ESF#8 (Public Health and Medical Services), ESF#11 (Food and Agriculture), and the Terrorism Incident Annex. The Ohio Department of Health, or ODH, is the Primary Agency for ESF#8 while the Ohio Department of Agriculture, or ODA, is the Primary Agency for ESF #11. ODH has a central office in Columbus and four district offices. Ohio also has one hundred and thirty-six local health districts. In the event of a foodborne bioterrorist attack, ODH would support the local health districts by providing health related services and supplies. ODA would coordinate the inspections of food

establishments, ensure the safety and efficacy of foods they regulate, inspect food processing facilities and distributors, collect and analyze food samples, and coordinate and oversee the destruction of contaminated products (Ohio EMA, 2009).

As part of the EOP, the Terrorist Incident Annex applies to specific terrorist acts and operations that include biological events. It identifies, among other sites, "agricultural and food production, including farms, auction markets/concentration yards, and processing, slaughter, storage and distribution sites/facilities" (Ohio EMA, 2009:TIA-4) as potential targets for terrorism. Of the eleven essential capabilities that the annex addresses, four of them would directly relate to biological terrorism: epidemiological surveillance and investigation, food and agriculture safety and defense, laboratory testing, and response and decontamination. The Ohio Homeland Security, or OHS, and the Ohio State Highway Patrol, or OSHP, would share as the Primary Agencies with thirteen other state departments as potential Supporting Agencies. Once an act of bioterrorism affected Ohio, the SEOC would become operational and the Governor would identify the State Coordinating Officer to work with federal agencies such as FEMA (Ohio EMA, 2009).

ODH would lead the epidemiological surveillance and public health investigation efforts, working with law enforcement, to identify the source of disease. ODH would also make public health recommendations for intervention. ODH would compile and analyze surveillance data, use pattern recognition to detect the suspected outbreak, and maintain a chain of custody of evidentiary materials. The epidemiological investigation would include public health or agricultural investigators examining the location of the suspected outbreak and victims involved to identify the exposure and the disease

involved. Samples would be taken to state laboratories for identification and analysis with control measures being recommended. Finally, the spread and containment of the outbreak would be monitored (Ohio EMA, 2009).

ODA, ODH, and the Ohio Department of Natural Resources, or ODNR, share the lead for the food and agriculture safety and defense capability. In the event of a foodborne bioterrorism attack, these departments would provide food safety laboratory and diagnostic support and technical assistance due to their subject matter expertise. These lead departments, with several supporting departments, would direct food and agriculture inspectors to the locations of the suspected contamination and coordinate a variety of food and agriculture operations. This would include the preservation of food and agriculture evidence; food and agricultural recovery; food processing, cleaning, and decontamination; and contaminated food disposal. These state departments would conduct epidemiological investigations, actively search for possible food contamination, conduct food safety laboratory detection screening and confirmation, disseminate these results to appropriate personnel, and maintain a chain of custody for all associated evidence. They would also conduct product tracing to determine the source, destination, and disposition of contaminated food and identify those populations and locations at risk. Through product recall, administrative detention, and plant closures, the state would control the contaminated food products at the facilities suspected of being contaminated (Ohio EMA, 2009).

ODA, the Ohio Environmental Protection Agency, or OEPA, ODH, and the Ohio National Guard, or ONG, serve as lead state departments and agencies for the laboratory testing capability. The Weapons of Mass Destruction Civil Support Team is part of the

ONG and are able to rapidly arrive at locations of contamination and assist first responders in biological identification and provide medical and technical advice. The lead state departments would, in the event of food bioterrorism, direct the laboratory testing of the samples and specimens collected and report the results. They would immediately notify the appropriate public health, agriculture, public safety, and law enforcement officials of presumptive and confirmed laboratory results of a biological threat agent (Ohio EMA, 2009).

ODH, OEPA, and ODA would serve as the lead for the hazardous materials response and decontamination capability. These state departments and agencies would conduct the decontamination operations following a food bioterrorism attack. All facilities involved with the contaminated food would be considered contaminated itself until after proper decontamination (Ohio EMA, 2009).

Inspection and regulation

To make sure that the foods we buy are safe to eat, the food is inspected by the producer, the retailer, the state food safety department, the Food Safety and Inspection Service (FSIS) of the USDA, and most importantly, by the consumer. While a consumer's inspection is usually visual, the other inspectors are able to take more precise measurements in an effort to detect for foodborne pathogens. However, there are two facts about food inspection. First, inspectors cannot inspect safety into our food. Second, even with the best inspection system available, inspectors would not be able to completely eliminate the risk of biological contamination in our food. Even the most rigorous food safety programs will not guarantee food safety if they are not properly implemented and managed (Buckley, 2010).

Because nearly every regulatory food safety measure is applied at the food processing phase (Buckley, 2010), much effort has been focused on food producers. Food producers are in the food business to make money; therefore, to gain their compliance to food regulations, food producers must be persuaded that there is economic benefit (Buckley, 2010). Using a carrot and stick method, all those along the food production chain must be convinced of the benefits of safe food and the increased cost of producing or selling contaminated food. The continuance of business based upon return customers should encourage more sampling, as needed, as incentive enough, while the lack of business due to bad press, etc., following the sale of food contaminated with foodborne pathogens should serve as a deterrent. Regulators could also deter noncompliance with the threat of more frequent inspection and fines (Buckley, 2010).

Not all inspection programs are managed equally, not even within the US federal government. It is interesting to note a finding of the HHS' Inspector General that facilities under USDA/FSIS jurisdiction that process meat, poultry and processed eggs are constantly inspected, while less than half of those facilities under FDA jurisdiction that process seafood, fruits and vegetables, cheese, and bakery products were inspected even once between 2004 and 2008 (Buckley, 2010:17; HHS, 2010b).

Different countries do not share the same standards of food production. This is apparently the case between the US and Mexico. Due to this, the rate of foodborne illness outbreaks in the US has increased since the North American Free Trade Agreement took effect in 1994 (Buckley, 2010).

How an Outbreak is Investigated

All foodborne outbreaks should be investigated as rapidly as possible to discover the source of the outbreak and properly treat the infected and prevent any additional infections. The Surgeon General of the Army and the US Army Medical Center and School (Dembeck, et al., 2007) provide the following ten steps to follow in investigating an outbreak. Note that these steps may not occur in order.

Ten Steps in an Outbreak Investigation (Dembeck, et al., 2007:43)

1. Prepare for fieldwork.
2. Verify the diagnosis. Determine an outbreak exists.
3. Define the outbreak and seek a diagnosis.
4. Develop a case definition and identify and count cases.
5. Develop exposure data with respect of person, place, and time.
6. Implement control measures and continually evaluate them.
7. Develop the hypothesis.
8. Test and evaluate the hypothesis with analytical studies and refine the hypothesis.
9. Formulate conclusions.
10. Communicate findings.

Step 1. Prepare for field work. To conduct an investigation, the necessary personnel, equipment, and laboratory capabilities must be ready. Personnel must be trained and equipment must be functioning properly. Communications must be established prior to the investigation.

Step 2. Verify the diagnosis. Determine an outbreak exists. This is where the actual investigation starts. At the onset of the investigation, the magnitude of

the outbreak is usually unknown. That is why existing surveillance information and increased surveillance efforts are used to determine if this event is truly an outbreak of concern.

Step 3. Define the outbreak and seek a diagnosis. Historical, clinical, epidemiological, and laboratory information is gathered so that a diagnosis can be created.

Step 4. Develop a case definition and identify and count cases. The case definition includes the laboratory and clinical features that is common to all infected people. These features should be as objective as possible, such as a certain temperature of fever. Defining the cases allows the investigator to count cases and make comparisons between those infected and those who are healthy. Patients, family members, peers, and others are interviewed to obtain the necessary information. Important information includes date of illness, symptoms, contact information for others to be interviewed, and medical care provided. At this point, an epidemic curve can be created from which information about the outbreak can be extrapolated.

Step 5. Develop exposure data with respect of person, place, and time. Now that the cases have been identified, exposure information based upon person, location, and time is determined. A case control study is made by comparing infected and well persons potential exposures or risk factors for disease.

Step 6. Implement control measures and continually evaluate them. Control measures, such as closing a suspected restaurant or a product recall, are taken to limit the spread of the infection and should be taken quickly and modified as more information becomes available.

Step 7. Develop the hypothesis. A hypothesis of how the outbreak occurred, from what food source it is spreading, and the risk to uninfected people is made. The hypothesis is based on the characteristics of the disease and the infected people.

Step 8. Test and evaluate the hypothesis with analytical studies and refine the hypothesis. Once a hypothesis is developed, data is collected to see if it supports this hypothesis or not. If not, the hypothesis may be refined. Based upon the hypothesis, the control measures from step 6 may need to be modified.

Step 9. Formulate conclusions. In this step, conclusions are made concerning the nature of the disease and the route of exposure.

Step 10. Communicate findings. Findings are communicated through the media or other publications based upon the urgency of the notification to the public and medical personnel.

See Figures 8 and 9 that pictorially depict the sequence of investigating and reporting foodborne outbreaks. Figure 10 shows how the 2008 *Salmonella* Saintpaul outbreak was investigated.

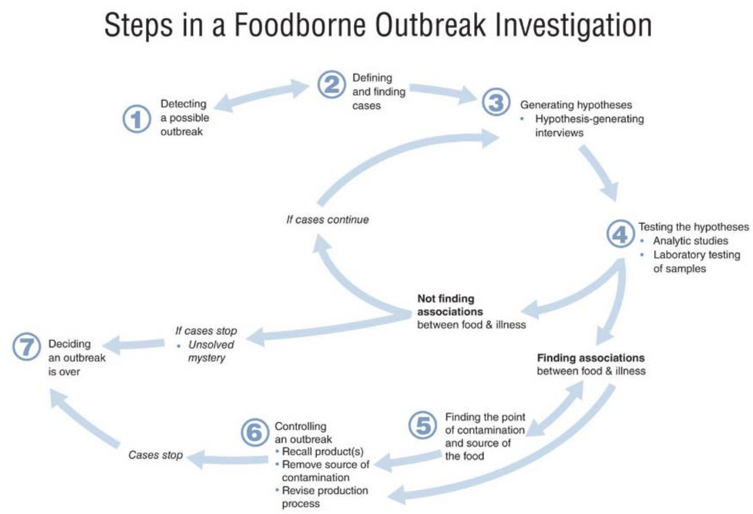

Figure 8. Investigating Foodborne Outbreaks (CDC, “Foodborne Outbreak”, 2011a)

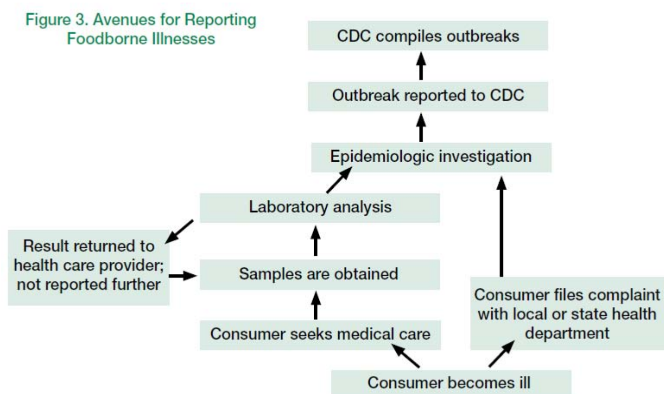

Figure 9. Avenues for Reporting Foodborne Illnesses (DeWaal, et al., 2011).

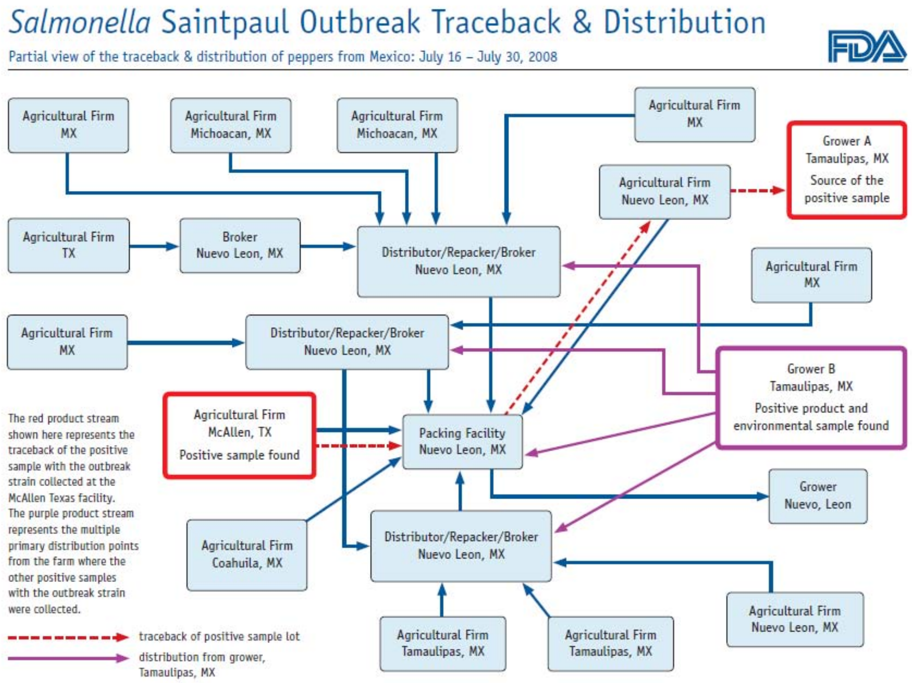

Figure 10. *Salmonella* Saintpaul Outbreak Traceback and Distribution (FDA, 2008).

Education

We may not be able to completely stop bioterrorism, but the public could learn safe food handling and preparation practices to mitigate any effects a bioterrorism attack might have. This leads to education of the public. It could be argued that consumers have the least understanding about their role in food safety and that few of them understand fully that the foods they consume can make them sick and that they must assist in their food's safety (Buckley, 2010). This is relevant especially for young consumers who may lack even the basic skills required to cook their food.

So, how do you educate the public? The American Academy for Microbiology, or the Academy, recommends that "research aimed at designating and disseminating effective educational resources about safe food handling practices and the risks from

consuming tainted food is the key to reducing the risk of foodborne illness caused at the consumer level" and that this education should start "from youth onward" (Buckley, 2010:23). The Academy recommends that the fundamentals of safe food handling should be taught in school, especially in elementary and middle schools before the children are old enough to develop bad habits (Buckley, 2010). They recommend that food safety could be taught in health, science, and home economics classes.

Now, how do you educate adults? The Academy recommends providing food safety information in a variety of places where adult consumers would find the information. This includes in magazines, during talk shows and cooking shows, in social networking tools like Facebook, on youTube videos, in day care centers, at church suppers, at health care providers, in children's television shows, at local health departments, and in store displays (Buckley, 2010).

People will make their own determinations as to whether or not to follow these food safety recommendations. Governments and public health organizations can make the information available, but they cannot control the behavior of the consumer (Buckley, 2010).

III. Methodology

While many countries provide food to the US, this study is limited to food imported from Mexico into the US. Much of the research was conducted by a literature review. This includes how different levels of government and organizations plan, prepare, and respond to the threat of bioterrorism. For information not found in published documents, organizations or experts in that particular field were contacted directly.

The beginning of this process is the Mexican farms. By tracing the path from our supermarkets and restaurants back to Mexico, I discovered the route our food takes and identified vulnerabilities. Analysis of these vulnerable points led to what I believe may be done to keep Americans safer.

Contaminated food outbreaks occur naturally every year and are reported by sources such as the CDC, WHO, ProMED, and state health departments. This study uses as many foodborne outbreaks in the US as could be found. It should be pointed out that the list of outbreaks used in this study is not exhaustive and may even represent a small portion of the actual foodborne outbreaks. However, the outbreak information presented should provide insight into some important characteristics of the different foodborne pathogens. The outbreaks are listed in Appendix F, tabulated in Appendix G, quantified in the Literature Review chapter, and analyzed in the Results chapter.

The objectives of this study are recommendations on what can be done to reduce or eliminate the threat of biological terrorism through deliberately-contaminated food imported from Mexico. There are several options that can be taken. See Figure 11 for a diagram of the range of options for change. One option is to maintain the status quo or

make no changes. This might be a recommendation if everyone is executing the correct actions in the exact way they need to and refraining from those actions that are either unnecessary or counterproductive.

A second option that can be taken is to do less than what is being done now. This can be completed by taking an activity that is currently being conducted and either decreasing that activity (for example, less inspections) or eliminating that activity (for example, no more inspections).

A third option that can be taken is to do more than what is being done now. This can be completed by increasing the frequency of an activity (for example, inspect every month instead of every year), increasing the quality of an activity (for example, inspect for three pathogens instead of just two), or add another activity that is currently not being conducted (for example, start inspecting).

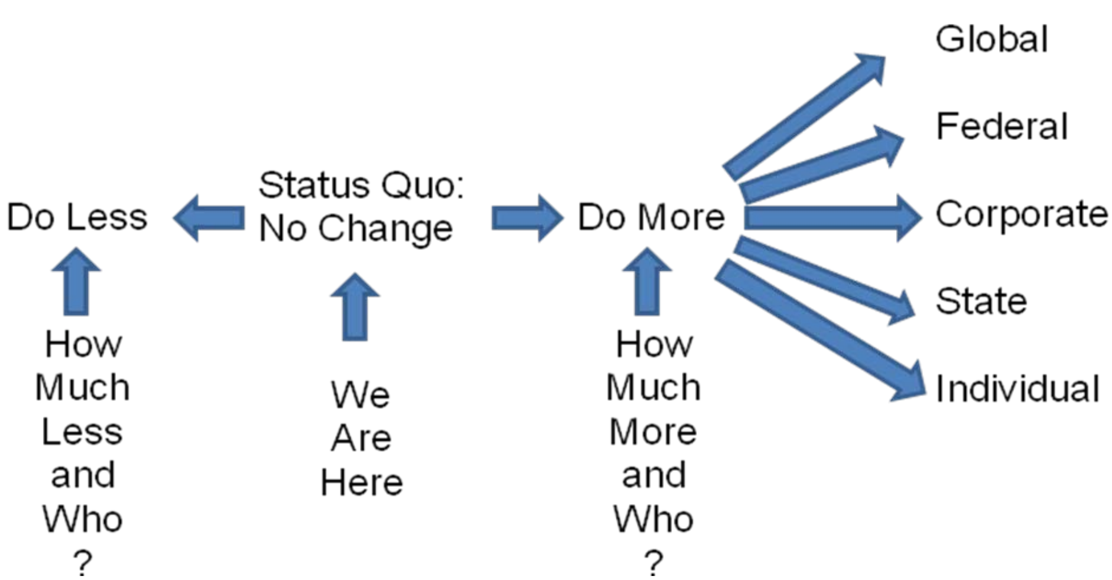

Figure 11. Range of Options for Change.

IV. Analysis and Results

Food Production Process

Vulnerable Points

The American Academy for Microbiology, in its report on global food safety, viewed protecting food as a "systems approach" where the process, from agricultural production to consumer consumption, is a "continuous system". Points where contamination is possible are identified, procedures are implemented to identify violations in food safety practice, and farm workers are provided with resources, training, and incentives required to consistently apply those safe procedures (Buckley, 2010). "Everyone in the process must share the responsibility of maintaining an unbroken chain of safe practices" (Buckley, 2010:9) because, viewing the food production process as links in a chain, "if one link in the food production chain breaks and compromises the microbial safety of a food item, tainted food may make it all the way to a consumer's table" (Buckley, 2010:33).

Usually, the situations that are most vulnerable to deliberate contamination are those where food changes hands. Also, the probability for deliberate contamination of food is likely to increase as it nears production and distribution. However, the probability for greater morbidity and mortality usually increases as the contaminating biological agent is introduced closer to the point of consumption (WHO, 2008).

The vulnerability of the food we eat starts at the very beginning of the food production process. Contaminated water can be introduced to plants or animals as they grow and mature. Bioterrorists can also inject pathogens directly into the plant or animal, including right before harvest or slaughter. Infected animals often would become sick

and plants would rot or decay and lose their appeal, and food safety officers would have more time to detect the attack if it occurred this early in the process.

One of the more vulnerable points in the food production process is when the food is being combined with other foods. The addition of “extra” ingredients might go unnoticed. Additionally, a food processing company must trust people to perform the operations that prepare the food for public consumption. The greater the number of people with access to the processing food, the more vulnerable the food is to contamination.

Food service is another point where food is vulnerable to deliberate contamination and has been used before in previous biological attacks in the US. In both the 1984 Rajneeshee *Salmonella* attack and the 1996 *Shigella dysenteria* contamination, stated in the “Previous Bioterrorist Attacks” section, the biological pathogen was added to the food (salad bar and pastries) right before consumption. It is at the point of consumption, usually, where most of the controls put in place to protect the food from contamination are removed.

Of all the phases in the food production process, one could argue that the one where the participants have the least understanding of their obligations in the safety of food is the consumers themselves (Buckley, 2010). Failure to properly refrigerate or cook certain foods, unsanitary preparation surfaces or utensils, or failure to adequately clean fruits and vegetables could encourage growth of foodborne pathogens and cause illness. However, once the consumer has purchased the food and brought it home, the food is now widely dispersed and usually there are better ways for terrorists, in this situation, to affect the individual people.

See Table 6 for a summary of vulnerabilities.

Table 6. Summary of Vulnerabilities

Where food changes hands
At the very beginning of the food production process
When food is being combined at a food processing facility
At food service
At the consumer level

Foodborne Pathogens

Analysis of Previous Biological Outbreaks

This study found that the four most frequent causes of foodborne outbreaks from 1977 to 2010 were *Salmonella*, *E. coli*, *Listeria*, and *C. botulinum*. As part of the analysis of Salmonella, the 1994 outbreak of ice cream contaminated with *Salmonella enteritides*, resulting in 224,000 infections, was sometimes ignored due to the large number of infections skewing the analytical results. Analysis of these four organisms in Table 7 reveals the following findings.

Table 7. Number of Outbreaks, Deaths, Deaths per Outbreak, Infections, and Infections per Outbreak for the Four Most Frequent Causes of Foodborne Outbreaks 1977-2010 (Appendix F)

	Salmonella	***E. coli***	***Listeria***	***C. botulinum***
Outbreaks	17	10	13	11
Deaths	7	5	105	2
Average Number of Deaths per Outbreak	0.4	0.5	8.1	0.2
Infections	245,257	1,269	472	191
Average Number of Infections per Outbreak (without 1994 *Salmonella* outbreak)	1329	127	36	17
Median Infections per Outbreak	183	39	21	8

First, not only did *Listeria* cause the most deaths overall, it caused the largest average number of deaths for each outbreak, 8.1, compared to less than one for the other three organisms. Outbreaks of *Salmonella*, *E. coli*, and *C. botulinum* may or may not result in one death. However, when a *Listeria* outbreak occurs, expect people to die. While about one-third of the *Listeria* outbreaks result in no deaths, three other outbreaks have resulted in 16, 17, and 48 deaths. See Figure 12.

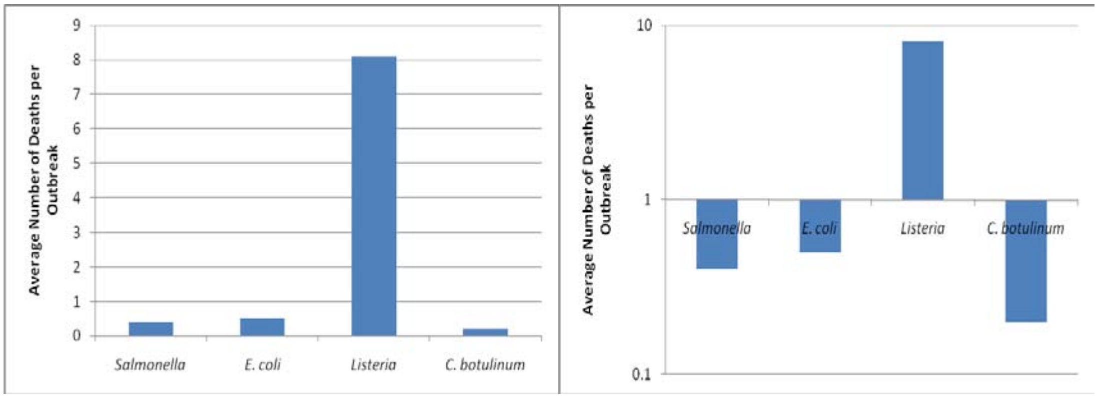

Figure 12. Average Number of Deaths per Outbreak for the Four Most Frequent Causes of Foodborne Outbreaks 1977-2010 (Appendix F)

Second, the average *Salmonella* outbreak infected significantly more than the other three organisms with a median of 183 infections and with four outbreaks infecting more than one thousand. See Figure 13. Note that the number of infections is represented by a logarithmic scale, so *Salmonella* is two orders of magnitude, or one-hundred times, that of *E. coli*. *Salmonella* is responsible for the four largest outbreak infections in this study, nine of the ten largest outbreaks, and fourteen of the twenty-one largest outbreaks.

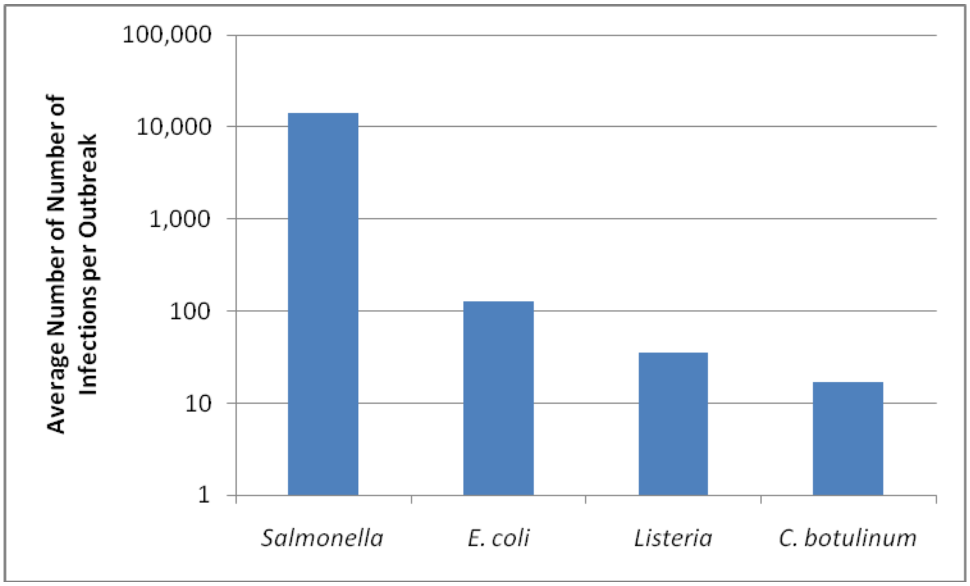

Figure 13. Average Number of Infections per Outbreak for the Four Most Frequent Causes of Foodborne Outbreaks 1977-2010 (Appendix F)

Figure 14 graphically displays the number of outbreaks per year for the four foodborne pathogens. While *Listeria* and *C. botulinum* appear relatively constant with an outbreak appearing occasionally, *Salmonella* and *E. coli* appear to have greatly increased since 2006. Figure 15 displays the total number of outbreaks by year. Notice that it also indicates that foodborne outbreaks increased since 2006. The large number of *Salmonella* outbreaks, with help from *E. coli*, causes this to occur.

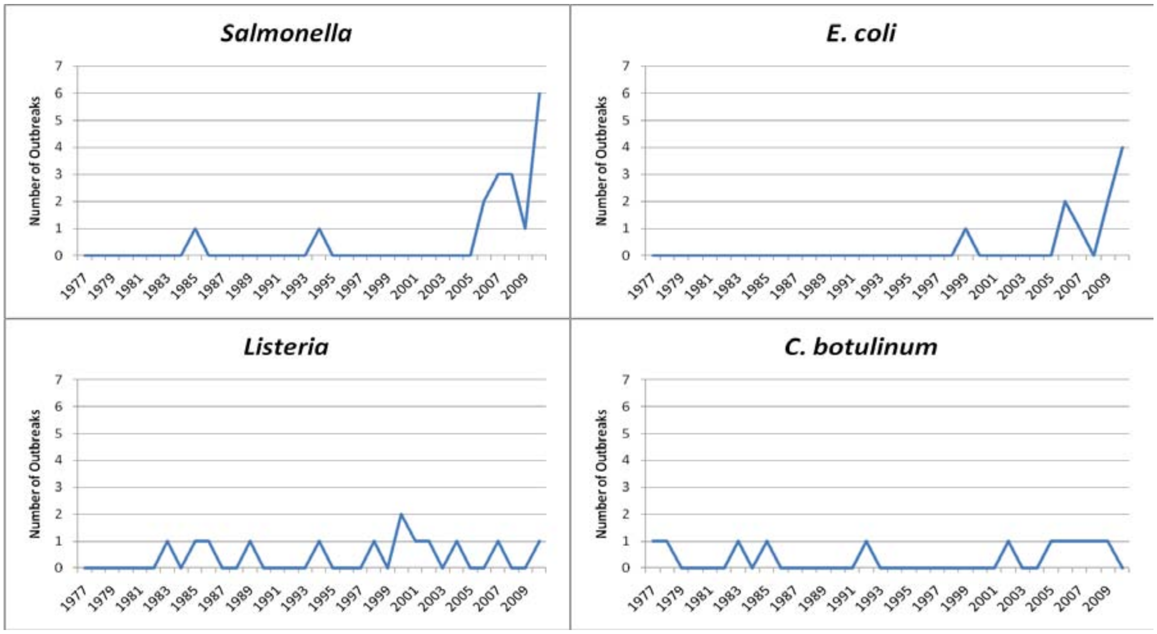

Figure 14. Number of Outbreaks per Year for *Salmonella, E. coli, Listeria,* and *C. botulinum* 1977-2010 (Appendix F)

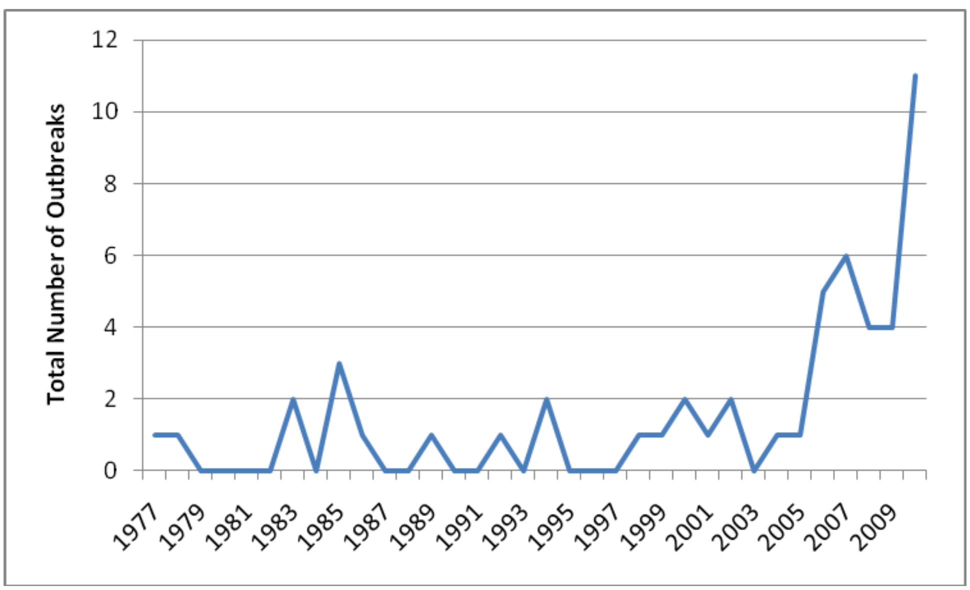

Figure 15. Total Number of Outbreaks per Year for the Four Most Frequent Causes of Foodborne Outbreaks 1977-2010 (Appendix F)

Case Fatality Rates

The case fatality rate is the number of death for each infection displayed as a percentage. The equation is as follows:

Case Fatality Rate = (Number of Deaths / Number of Infections) x 100%

While not all infected people are counted towards an outbreak (they do not seek medical attention, for example), this information may be helpful to the terrorist if the desired effect is the maximum number of deaths. See Table 8 for the case fatality rates for the four foodborne pathogens in this study.

Table 8. Case Fatality Rates for the Four Most Frequent Causes of Foodborne Outbreaks 1977-2010 (Appendix F)

Case Fatality Rates	***Salmonella* ***	***E. coli***	***Listeria***	***C. botulinum***	**Total**
Total	0.003%	0.394%	22.246%	1.047%	0.048%
1977-2006	0.025%	0.290%	21.225%	1.136%	0.044%
2007-2010	0.001%	0.855%	53.333%	0%	0.281%

*** Includes 1994 *Samonella* case.**

Figure 16 displays the results from Table 8. It indicates that *Salmonella* very rarely causes a death. *Listeria*, alternatively, takes a life for every five infected people.

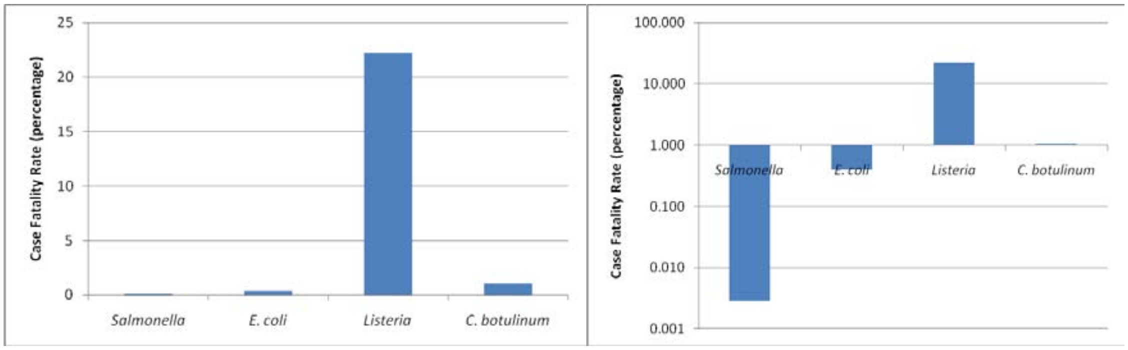

Figure 16. Case Fatality Rates for the Four Most Frequent Causes of Foodborne Outbreaks 1977-2010 (Appendix F)

In an effort to determine if the outbreaks are deadlier, the case fatality rates were divided into two groups. About half of the outbreaks studied occurred from 2007 to 2010, so this represents the more recent group. The earlier group are those outbreaks that occurred from 1977 to 2006. Efforts to break up the time period into more than two groups resulted in many time periods without a death, resulting in undefined numbers. The later group was compared to the earlier group and the total average in Figure 17. *Salmonella* and *Listeria* show an increase, suggesting that they are becoming deadlier, while *E. coli* and *C. botulinum* show a decrease, suggesting that they are becoming less deadly. Note that in this study, none of the 15 infected people died from *C. botulinum* since 1978, so the case fatality rate for 2007-2010 is zero.

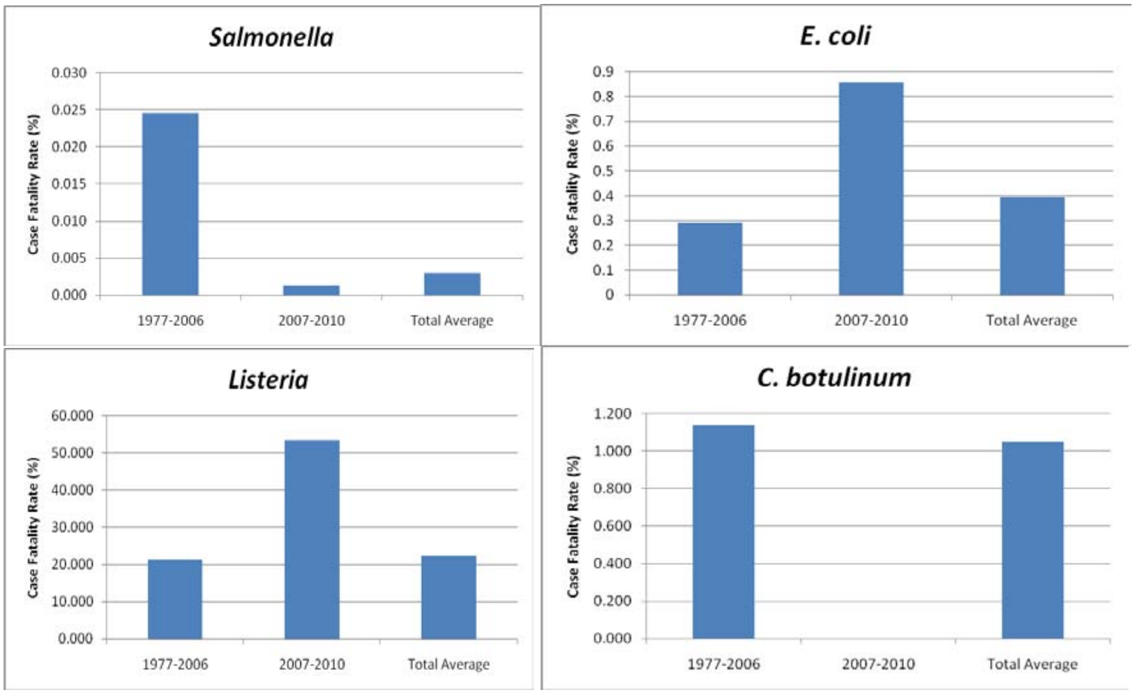

Figure 17. Case Fatality Rates per Year Group for the Four Most Frequent Causes of Foodborne Outbreaks 1977-2010 (Appendix F)

All of the outbreaks taken together demonstrate an increasing trend and that outbreaks are becoming deadlier. See Figure 18.

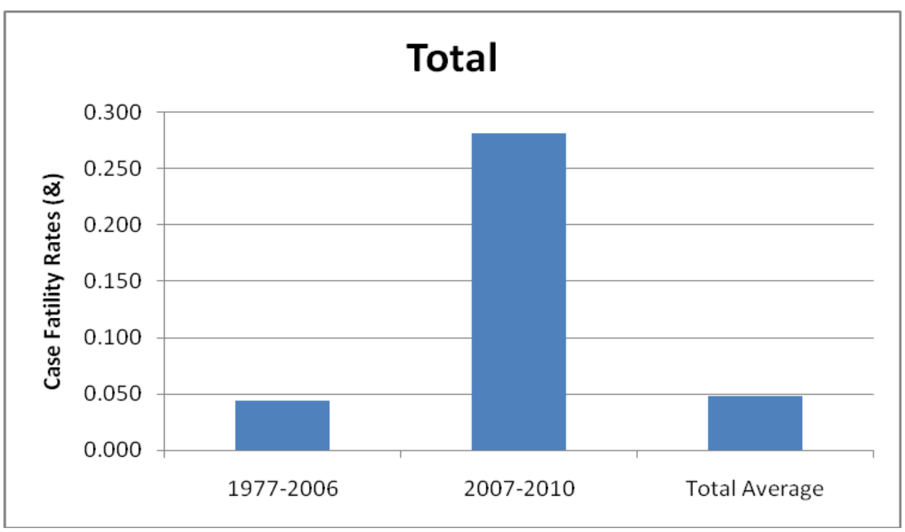

Figure 18. Overall Trend in Case Fatality Rates per Year Group for the Four Most Frequent Causes of Foodborne Outbreaks 1977-2010 (Appendix F)

Increased Number of Outbreaks

Figure 15 shows that there has been an increase in foodborne outbreaks. The WHO (2002) observed that the incidence of salmonellosis, for example, has increased in the past 34 years on many continents. The following are reasons why this study could show that the number of foodborne outbreaks is on the rise.

The numbers in the study are flawed. This study does not include all of the foodborne outbreaks since 1977. The assumption made is that the outbreaks included in this study are substantially representative, both in number and in characteristics, so that accurate conclusions can be asserted, such as types of most frequent pathogens and outbreak frequency over time. Several reputable sources agree with the overall statement that the occurrence of foodborne outbreaks is increasing (WHO, 2002; Colorado Department of Public Health and Environment, 2010). Even though the CDC reported ("Trends", 2011b) a 20% reduction in illnesses, its study only tracked five illnesses, one of which showed an increase, and reported relative rates of laboratory-confirmed infections, not number of outbreaks.

There has been an improvement in reporting. The surveillance system PulseNet, developed in 1995 following a large *E. coli* outbreak in 1993, significantly increased the ability of investigators to connect geographically-dispersed foodborne illnesses (DeWaal, et al., 2011). Around the world, the average time from the start of an outbreak to its discovery decreased from 30 days in 1996 to 14 days in 2009 while the start of the outbreak to the start of public communication about the outbreak also decreased from 40 days to 19 days for the same time period (Ellison, 2010).

There has been a recent recognition of foodborne pathogens. It was not until 1982 when E. coli O157:H7 was first recognized as a human pathogen (Ecolab, 2011). *Listeria monocytogenes* has also only recently been recognized as a foodborne pathogen (CDC, "Listeriosis," 2011c; WHO, 2002). Tauxe (2002) has stated that as we have been able to control or eliminate well-established pathogens, new pathogens have emerged and then predominated.

Foodborne pathogens have adapted. The changes experienced by species of microorganisms can result in new pathogens. These same changes can cause known pathogens to become more pathogenic or more survivable in the environment. One of these changes may be resistance to human intervention such as antibiotic resistance (see *Salmonella*'s resistance to fluoroquinolones in Mlot, 2000).

Change in consumer lifestyles. There has been an increase in the number of people who eat out. The USDA (ERS, 2004) estimated that Americans will increase spending at full-service restaurants and fast food chains by 18 and 6 percent, respectively, between 2000 and 2020. This is based upon the changing demographics and lifestyles of Americans: increase in income, increase in the average age, and decrease in the proportion of "traditional" households which spend less money per person on food away from the home. Often, the speed of service provided by that teenager or college student at the fast food chain is no match for the safe food preparation provided by the mature mother or father preparing the family meal at home.

Increase in population. The US population has increased to 308,745,538 (Census, 2010). More people means that there are more people to become infected, even if the rate of infection remains the same.

Globalization of the food supply. There was a time when the American consumer looked forward to the summertime for the wide variety of produce that was not available at other times of the year. Now, this produce is available year round from countries with longer and unlimited growing seasons and from countries south of the equator with a growing season months before and after ours. With the increased number of countries importing food into the US and the lower standards of food processing, there is an increased probability that food will arrive infected.

New pathogens have been introduced or reintroduced to the US. Before 1991, epidemic cholera had not been present in South America during the 1900s. First Peru, then six other countries in the Americas, including 14 cases in the US, suffered outbreaks, perhaps resulting from reintroduction from Chinese shipping (CDC, "Epidemiologic Notes and Reports Listeriosis", 1991; WHO, 2002).

V. Findings, Recommendations, and Conclusion

Introduction

The Secretary of the USDA has often said words to the effect that America's food supply is the most abundant, the safest, and one of the cheapest in the world (Glickman, 2000). This is especially true for a food supply that feeds 307 million people. Also, despite the frequent natural biological outbreaks that occur, no act of bioterrorism has occurred that would warrant massive changes to the way we are currently operating. I hesitate to recommend the creation of more governmental organizations, the granting of more power, or the legislation of stricter regulations or an increase in inspections. There are enough people striving for these ends and I believe that much of that is either ineffectual or counterproductive. We will never have a perfect system in place to prevent all acts of terrorism. We cannot inspect everything for every pathogen and other contaminant at all stages of food production and processing. My purpose here is to recommend some things that may not be said enough but that I believe would keep our food supply, and therefore us, safer.

Findings and Recommendations

As a nation, there are things we can do to prevent a foodborne attack from taking place. The following are findings and recommendations from this study that we should do to prevent this attack.

Finding #1: Importing food from Mexico places American consumers at risk.

Mexico is corrupt. That corruption provides the opportunity for terrorists, including the drug cartels, to have access to the food that Americans eat. The opportunity

for terrorists to contaminate our food supply is greater when the food travels a longer distance, crosses more borders, and changes more hands. The US is dependent upon Mexico for some of the food that we eat, but we should not be that dependent. Americans are at a higher risk of a foodborne terrorist attack when the food comes from Mexico than if that same food were to be produced within the US.

Recommendation #1: Increase American food production.

The US should increase its production of food with the goal of producing a self sufficient food supply. The federal government, through the USDA, should encourage this agricultural growth by supporting the creation and maintenance of domestic markets and facilitate coordination of underserved communities where access to farmland is limited. Local food producers should attempt to sell their food locally while consumers and food retailers (supermarkets, etc.) should buy local food first. Consumers should grow produce in family fruit and vegetable gardens and raise livestock as they are able. The benefits of decreasing our dependence on imported food include fresher and safer food. We may not be able to produce all of the varieties of food Americans enjoy in the US, such as cocoa beans used for chocolate, but we should import as little as possible. If these efforts fail, the federal government, through the USDA, should limit the amount of food imported. Currently, we cannot inspect as well as we would like because of the magnitude of imports crossing our borders daily. If the amount of food coming into the US became small enough, we could inspect much better than now. Identifying the source of the food grown, raised, and processed may be placed on the labels of the food product sold. Food in supermarkets may be segregated by country origin where all food products from Mexico, for example, would have its own section. This would allow the consumer

to simply avoid the food from certain countries. Information provided to the public is not a bad thing. However, this may not be a good idea because this might increase the cost of food, limit the availability and variety of food, and consumers might not care or may even prefer imported food.

The secondary effects of increasing US food production would be a decrease of exports from the farms in Mexico. If the Mexican farms were not able to find another buyer of their products and if the trade shortfall caused the farmers' business to become unprofitable, all those involved in the food production process would need to find a way to make up that shortfall in revenue. As stated about Mexican corruption, this act could strengthen an already powerful drug cartel system. Mass relocations of families to larger cities and perhaps across the US border could result. The increase in American food production would have to be closely monitored so as to not threaten the security of the US and push a neighboring country over the edge of economic instability.

Finding #2: The consumer is the greatest vulnerability to the food production process.

From the farm to the market and restaurant, food is usually well regulated by government agencies from the USDA, FDA, and state health departments. Inspectors do not enter consumers' houses and check to see if the food is stored or prepared properly. Also, there is no training or test to qualify to become a consumer. The American consumer is the weakest link of the food production chain and is the greatest vulnerability to an act of bioterrorism.

Recommendation #2: Better inform the consumer on food safety issues.

This includes proper storage and preparation of food. Most of the same safe food handling procedures that keep a consumer safe from natural biological outbreaks should provide protection from a bioterrorism attack using the same pathogen. See the recommendations provided under "Education" at the end of the Literature Review chapter for a more complete description. HHS and state and county health departments should use social networking media such as Facebook, widgets, blogs, Twitter, podcasts, mobile alerts, and online videos to get the information out.

The intent of the actions contained in the above listed recommendations is to dissuade the terrorist from executing the foodborne attack. If deterrence fails, we must be able to take responsive actions. There are things we can do to respond to a foodborne attack that will mitigate or prevent damage. The following are findings and recommendations from this study that we should do to respond to an attack.

Finding #3a: Quicker identification results in fewer infections.

The shorter the lag time between symptoms and outbreak identification and treatment, the fewer people that will become infected and the more lives that will be saved. The most important part of an investigation of a suspected foodborne outbreak is the identification (WHO, 2008). Also shown previously, an *E. coli* outbreak that was detected in 18 days versus 39 days resulted in less than five percent of the illnesses and no deaths (Institute of Medicine, 2008).

Finding #3b: Foodborne outbreaks have become deadlier and more frequent.

The total number of foodborne outbreaks appear to have become deadlier and have increased in frequency, especially *Salmonella* and *E. coli*. The pathogen of choice for the bioterrorist would be *Salmonella* for maximum infections and *Listeria* for maximum deaths.

Recommendation #3: Expand research in rapid identification.

The ability to trace the route that food has taken though the entire food production process is essential for limiting foodborne infections during an outbreak. Federal and state governments should fund research into further development of networks such as PulseNet, FoodNet, OutbreakNet, and ESSENCE. Government agencies should meet with consumers and industry to better understand the food production processes that are currently being used and developed.

Finding #4: Investigators require some time to identify outbreaks.

Following the ten steps in an outbreak investigation could take weeks of intense investigative work, especially if the outbreak covers a large geographic area with only a few infections from each state affected.

Recommendation #4: Increase public awareness of the importance of reporting illness.

Consumers who become sickened by foodborne pathogens should report their sickness to the local health department. This should occur even if the infected choose to treat the sickness at home instead of seeking medical attention at a hospital. This additional information would alert public health agencies earlier of a bioterrorism attack.

HHS and state and county health departments should use social networking media and other means to educate the public. Physicians and pharmacists should ascertain and report by name anyone who is infected.

Conclusion

There exists a thought that a deliberate attack with an engineered pathogen would be more devastating than a natural foodborne outbreak (see the WHO comment that “if the unintentional contamination of one food, such as clams, can infect 300,000 individuals with a serious debilitating disease, then a concerted, deliberate attack could be devastating, especially if a more dangerous agent was used” WHO, 2008:7). I disagree. I have demonstrated that terrorists have been unable to produce the infections or deaths caused by the largest natural foodborne outbreaks. Rather, the real threat of a bioterrorist attack through deliberately-contaminated food supplied from Mexico, resulting in mass casualties or deaths, does not come from a biologically engineered microorganism, but from the pathogens that frequently cause foodborne outbreaks. They have proven themselves to be able to survive through the food production process and arrive on our dinner tables despite our best efforts.

Appendix A. Value of US Agricultural Imports by Year
(ERS, 2010b)

Year	Value (in Millions of Dollars)	Year	Value (in Millions of Dollars)
1976	10,966	1993	25,117
1977	13,441	1994	27,024
1978	14,804	1995	30,255
1979	16,723	1996	33,511
1980	17,401	1997	36,148
1981	16,907	1998	36,894
1982	15,345	1999	37,673
1983	16,536	2000	38,974
1984	19,334	2001	39,366
1985	19,968	2002	41,915
1986	21,453	2003	47,384
1987	20,402	2004	53,989
1988	20,955	2005	59,291
1989	21,879	2006	65,326
1990	22,918	2007	71,913
1991	22,875	2008	80,488
1992	24,796	2009	71,699

Appendix B. Estimated Annual Number of Episodes of Domestically Acquired, Foodborne Illness, Hospitalizations, and Deaths Caused by 31 Pathogens and Unspecified Agents Transmitted Through Food in the US

(Scallan, et al., 2011)

Cause	**Illnesses**	**%**	**Hospitalizations**	**%**	**Deaths**	**%**
Major known pathogens	9,388,075	20	55,961	44	1,351	44
Unspecified agents	38,392,704	80	71,878	56	1,686	56
Total	47,780,779	100	127,839	100	3,037	100

Appendix C. Estimated Annual Number of Episodes of Domestically Acquired, Foodborne Illness, Hospitalizations, and Deaths Caused by 7 Major Pathogens Transmitted Through Food in the US

(Scallan, et al., 2011)

Pathogen	**Illnesses**	**Hospitalizations**	**Deaths**
Norovirus	5,461,731	14,663	149
Nontyphoidal *Salmonella* spp.	1,027,561	19,336	378
Clostridium perfringens	965,958	438	26
Campylobacter spp.	845,024	8,463	76
Toxoplasma gondii	86,686	4,428	327
Listeria monocytogenes	1,591	1,455	255
E. coli O157	63,153	2,138	20

Data were mostly from 2000-2008.

All estimates were based on the 2006 US population of 299,000,000 people.

Appendix D. Current List of Designated Foreign Terrorist Organizations (DOS, 2010b)

"Foreign Terrorist Organizations (FTOs) are foreign organizations that are designated by the Secretary of State in accordance with section 219 of the Immigration and Nationality Act (INA), as amended. FTO designations play a critical role in our fight against terrorism and are an effective means of curtailing support for terrorist activities and pressuring groups to get out of the terrorism business" (www.state.gov/s/ct/rls/other/des/123085.htm).

1. Abu Nidal Organization (ANO)
2. Abu Sayyaf Group (ASG)
3. Al-Aqsa Martyrs Brigade (AAMS)
4. Al-Shabaab
5. Ansar al-Islam (AAI)
6. Asbat al-Ansar
7. Aum Shinrikyo (AUM)
8. Basque Fatherland and Liberty (ETA)
9. Communist Party of the Philippines/New People's Army (CPP/NPA)
10. Continuity Irish Republican Army (CIRA)
11. Gama'a al-Islamiyya (Islamic Group)
12. HAMAS (Islamic Resistance Movement)
13. Harakat ul-Jihad-i-Islami/Bangladesh (HUJI-B)
14. Harakat ul-Mujahidin (HUM)
15. Hizballah (Party of God)
16. Islamic Jihad Union (IJU)
17. Islamic Movement of Uzbekistan (IMU)
18. Jaish-e-Mohammed (JEM) (Army of Mohammed)
19. Jemaah Islamiya organization (JI)
20. Kahane Chai (Kach)
21. Kata'ib Hizballah (KH)
22. Kongra-Gel (KGK, formerly Kurdistan Workers' Party, PKK, KADEK)
23. Lashkar-e Tayyiba (LT) (Army of the Righteous)
24. Lashkar i Jhangvi (LJ)
25. Liberation Tigers of Tamil Eelam (LTTE)
26. Libyan Islamic Fighting Group (LIFG)
27. Moroccan Islamic Combatant Group (GICM)
28. Mujahedin-e Khalq Organization (MEK)
29. National Liberation Army (ELN)

30. Palestine Liberation Front (PLF)
31. Palestinian Islamic Jihad (PIJ)
32. Popular Front for the Liberation of Palestine (PFLP)
33. PFLP-General Command (PFLP-GC)
34. al-Qaida in Iraq (AQI)
35. al-Qa'ida (AQ)
36. al-Qa'ida in the Arabian Peninsula (AQAP)
37. al-Qaida in the Islamic Maghreb (formerly GSPC)
38. Real IRA (RIRA)
39. Revolutionary Armed Forces of Colombia (FARC)
40. Revolutionary Organization 17 November (17N)
41. Revolutionary People's Liberation Party/Front (DHKP/C)
42. Revolutionary Struggle (RS)
43. Shining Path (Sendero Luminoso, SL)
44. United Self-Defense Forces of Colombia (AUC)
45. Harakat-ul Jihad Islami (HUJI)
46. Tehrik-e Taliban Pakistan (TTP)
47. Jundallah

Appendix E. US Food Imports from Mexico for 2009
(ERS, 2010b)

Category	**Amount (in Millions of Dollars)**
edible vegetables and certain roots and tubers	3,151.10
beverages, spirits and vinegar	2,333.90
edible fruit and nuts; peel of citrus fruit or melons	2,288.70
sugars and sugar confectionery	905.40
preparations of vegetables, fruit, nuts, or other parts of plants	636.60
preparations of cereals, flour, starch or milk; bakers' wares	605.40
fish and crustaceans, mollusks and other aquatic invertebrates	430.90
miscellaneous edible preparations	401.60
cocoa and cocoa preparations	355.20
coffee, tea, mate and spices	277.20
pharmaceutical products	238.40
meat and edible meat offal	134.80
animal or vegetable fats and oils and their cleavage products; prepared edible fats; animal or vegetable waxes	69.60
edible preparations of meat, fish, crustaceans, mollusks or other aquatic invertebrates	68.10
dairy produce; birds' eggs; natural honey; edible products of animal origin	61.30
oil seeds and oleaginous fruits; miscellaneous grains, seeds and fruits; industrial or medicinal plants; straw and fodder	51.40
lac; gums; resins and other vegetable saps and extracts	42.70
milling industry products; malt; starches; inulin; wheat gluten	42.50
tobacco and manufactured tobacco substitutes	22.70
cereals	16.80

Appendix F. Previous Biological Outbreaks

Contaminated food outbreaks occur naturally every year. The CDC, unless cited otherwise (CDC, "Outbreaks", 2010h), reports the following outbreaks:

Outbreak of *Listeria* Associated with Consumption of Chopped Celery. Ten people in Texas became infected with *Listeria* from eating chopped celery processed by Sangar Fresh Cut Produce in October 2010. Five people died (Texas Department of State Health Services, 2010).

***Salmonella* Egg Recall of August 2010.** A *Salmonella* Enteritidis outbreak sickened 2,508 Americans in 23 states from 2 May to 31 August 2010. The contaminated eggs were traced back to two egg farms in Iowa, which recalled about 550 million eggs from the US market (CDC, "*Salmonella*", 2010i). Because about 1,093 cases of *Salmonella* usually occur during this period, the CDC has lowered this estimate to about 1,519 cases related to this outbreak (CDC, "Investigation Update", 2010f).

Outbreak of *E. coli* O145 Infections Linked to Shredded Romaine Lettuce. Twenty-six people in five states became ill with *Escherichia coli* O145 infection from eating contaminated shredded romaine lettuce processed by Freshway Foods in Sidney, Ohio, 1 March to 20 May 2010.

Outbreak of *E. coli* O157:H7 Infections Associated with Beef from Fairbank Farms. Twenty-six people from eight states were infected with matching strains of *E. coli* O157:H7 from ground beef from 17 September to 6 November 2009. Approximately 545,699 pounds of ground beef products were recalled. Nineteen people were hospitalized with two deaths.

Outbreak of *E. coli* O157:H7 Infections Linked to Eating Raw Refrigerated, Prepackaged Nestle Toll House Cookie Dough. Sixty-five people from twenty-nine states were infected with *E. coli* O157:H7 from eating raw refrigerated, prepackaged Nestle Toll House cookie dough 1 March to 18 June 2009 (CDC, "Multistate", 2009a)

Outbreak of *Salmonella* Saintpaul Infections Linked to Raw Alfalfa Sprouts. Two hundred and thirty-five people from fourteen states were infected with *Salmonella* Saintpaul from consuming alfalfa sprouts from 1 February to 15 April 2009. Seven people were hospitalized.

Outbreak of *Salmonella* Saintpaul Linked to Salsa. One thousand four hundred and forty-two people from forty-three states were infected with *Salmonella* Saintpaul from consuming jalapeno peppers, serrano peppers, and/or tomatoes from 16 April to 11 August 2008. Two hundred and eighty-six people were hospitalized and two people died.

Outbreak of *Salmonella* Litchfield Linked to Cantaloupe from Honduras. Fifty-one people from sixteen states were infected with *Salmonella* Litchfield from consuming cantaloupe from Honduras from 10 January to 10 March 2008. Sixteen people were hospitalized.

Outbreak of *Salmonella* Agona Linked to Cereal from Malt-O-Meal. Twenty-eight people from fifteen states were infected with *Salmonella* Agona from consuming breakfast cereals from Malt-O-Meal from 1 January to 10 April 2008. Eight people were hospitalized.

Outbreak of *Listeria* Associated with Consumption of Whittier Farms Pasteurized Milk. Five people in Massachusetts were infected by *Listeria*

monocytogenes from consuming pasteurized milk produced by Whittier Farms in November 2007. All five patients were hospitalized and three died from sepsis attributed to the infection (ProMED, 2008; NewsInferno, 2008).

Outbreak of *E. coli* O157 Infections Linked to Topp's Brand Ground Beef Patties. Forty people from eight states were infected by *E. coli* O157 from consuming ground beef patties from 5 July to 24 September 2007. About 21.7 million pounds of frozen ground beef patties were recalled. Of the thirty-three known ill persons, twenty-one were hospitalized with no deaths.

Outbreak of Botulism Associated with Canned Chili Sauce. Eight people in three states were made ill from botulinum toxin from consuming hot dog chili sauce made by Castleberry's Food Company from 29 June to 7 August 2007. At least four of those sick were hospitalized (CDC, "Botulism", 2007).

Outbreak of *Salmonella* 4,[5],12:i:- Linked to Pot Pies from Banquet. Two hundred and seventy-two people from thirty-five states were infected with *Salmonella* 4,[5],12:i:- from consuming Banquet brand pot pies produced by the ConAgra Foods company from 1 January to 29 October 2007. Sixty-five people were hospitalized.

Outbreak of *Salmonella* Schwarzengrund Linked to Pet Food. Sixty-two people from eighteen states were infected with *Salmonella* Schwarzengrund from contact with dry pet food produced by Mars Petcare US from 1 January to 4 September 2007. Ten people were hospitalized.

Outbreak of *Salmonella* Wandsworth Linked to Snack Food. Sixty-five people from twenty states were infected with *Salmonella* Wandsworth from consuming

Robert's American Gourmet brand Veggie Booty, a snack of puffed rice and corn with a vegetable coating, from 1 January to 4 September 2007. Six people were hospitalized.

Outbreak of *Salmonella* Tennessee Linked to Peanut Butter. Four hundred and twenty-five people from forty-four states were infected with *Salmonella* Tennessee from consuming Peter Pan and Great Value peanut butter from 1 August 2006 to 16 February 2007. Seventy-one people were hospitalized.

Outbreak of *E. coli* O157 Infections Associated with Taco Bell November-December 2006. Seventy-one people from five states were infected by *E. coli* O157 from consuming food from Taco Bell from 20 November to 6 December 2006. Shredded lettuce was the most likely source of the outbreak. Fifty-three people were hospitalized.

Outbreak of *Salmonella* Typhimurium Linked to Tomatoes. One hundred and eighty-three people from twenty-one states were infected with *Salmonella* Typhimurium from consuming contaminated tomatoes from restaurants from 14 September to 2 October 2006. Twenty-two people were hospitalized.

Outbreak of *E.coli* O157:H7 Infections Associated with Consumption of Fresh Spinach. One hundred and eighty-three people from twenty-six states were infected by *E.coli* O157:H7 from consuming fresh spinach from 19 August to 5 September 2006. Ninety-five people were hospitalized and one person died. The FDA advised consumers to not eat fresh spinach or fresh spinach-containing products while one spinach company voluntarily recalled all of its fresh spinach-containing products.

Outbreak of *Listeria* from an Unknown Origin in Virginia. Five people in Virginia were infected by *Listeria* from an undetermined source from June to mid July 2004. (ProMED, 2004).

Outbreak of Botulism Type E Associated with Eating a Beached Whale. Eight people in western Alaska became ill from botulinum toxin type E from eating meals consisting of whale skin and blubber collected from an adult beached beluga whale that had been dead for several weeks 17 July 2002. Five of the eight affected people were hospitalized (CDC, "Outbreak of Botulism", 2003b).

Outbreak of *E. coli* O157:H7 Infections Associated with Attendance at the 1999 Washington County Fair, New York. Seven hundred and eighty-one people attending the Washington County Fair in New York State were infected by *E.coli* O157:H7 from drinking contaminated water. Seventy-one people were hospitalized and two people died (New York State Department of Health, 2000).

Outbreak of *Listeria* Associated with Consumption of Bil Mar Foods Hot Dogs and Deli Meats. Seventy-five people in fourteen states were infected with *Listeria monocytogenes* from consuming hot dogs and deli meats produced by Bil Mar Foods in early August 1998 to February 1999. Seventeen people died including five miscarriages or stillbirths. The CDC has called this the second largest *Listeria* outbreak in US history (Spake, 1999).

Outbreak of *E. coli* O157:H7 Infections Associated with Consumption of Radish Sprouts. About 8,000 children in Sakai City, Japan, became ill with *Escherichia coli* O157:H7 infection from eating contaminated radish sprouts prepared in school lunches in July 1996. Some of the children died (WHO, 2008; Mermin and Griffin, 1999).

Outbreak of *Salmonella enteritides* Infections Associated with Consumption of Ice Cream. *Salmonella enteritides* infected 224,000 people in 41 states from their

consumption of contaminated pasteurized liquid ice cream in 1994 (WHO, 2008; Hennesy, et al., 1996).

Outbreak of Botulism Type E Associated with an Uneviscerated, Salt-Cured Fish Product. Four people in New Jersey became ill from botulinum toxin type E from eating an uneviscerated salt-cured fish preparation in May 1992. All four affected people were hospitalized (CDC, "Outbreak of Type", 1992).

Outbreak of Hepatitis A Associated with Consumption of Clams. Nearly 300,000 people in Shanghai, China, were infected with hepatitis A from contaminated clams in 1988. This may have been the world's largest foodborne outbreak (WHO, 2008; Halliday, et al., 1991).

Outbreak of Restaurant-Associated Botulism Type B. Thirty-two people in Vancouver, Canada, became ill from botulinum toxin type B from eating at the White Spot Restaurant between 26 July and 5 September 1985. Seven affected people needed to be placed on ventilation (CDC, "Update", 1985b).

Outbreak of *Salmonella Typhimurium* Linked to Tainted Milk. At least 16,284 persons from six Midwestern states were infected with *Salmonella Typhimurium* from contaminated milk from Hillfarm Dairy in Melrose Park, IL, in March and April 1985. Four or five people died from being infected (Lecos, 1986).

Outbreak of *Listeria* Associated with Consumption of Mexican-Style Cheese. One hundred and forty-two people in California were infected by *Listeria monocytogenes* from consuming Mexican-style cheese from 1 January to 14 July 1985. Forty-eight people died (California, 2010; CDC, "Epidemiologic Notes and Reports Listeriosis", 1985a).

Outbreak of Botulism Type A in Peoria, Illinois. Twenty-eight people in Peoria, Illinois, became ill from botulinum toxin type A from eating contaminated sautéed onions on a patty-melt sandwich 14-16 October 1983. All affected people were hospitalized and 12 of those needed to be placed on ventilation (CDC, "Foodborne Botulism", 1984).

Outbreak of Botulism Type A in Clovis, New Mexico. Thirty-four people in Clovis, New Mexico, became ill from botulinum toxin type A from eating contaminated food at a restaurant April 1978. All affected people were hospitalized and two of those died (Mann, 1983).

Outbreak of Botulism Type B Associated with Consumption of Hot Sauce. Fifty-nine people in Pontiac, Michigan, became ill from botulinum toxin type B from eating contaminated hot sauce made from improperly home-canned jalapeno peppers at a Mexican restaurant 31 March to 6 April 1977 (Terronova, 1978). This was the largest incident of botulism food poisoning in the US.

Appendix G. Summary of Previous Biological Outbreaks
(From Appendix F)

Year	**Food**	**Died**	**Infected**	**Infection**
2010	duck eggs	1	63	*Salmonella*
2010	fruit dessert	0	37	*E. coli*
2010	frozen rodents	0	7	*Salmonella*
2010	school food	0	15	*Salmonella*
2010	bean sprouts	0	106	*Salmonella*
2010	cheese	0	37	*E. coli*
2010	ground beef	0	500	*Salmonella*
2010	unknown	0	3	*E. coli*
2010	celery	5	10	*Listeria*
2010	eggs	0	1,519	*Salmonella*
2010	lettuce	0	26	*E. coli*
2009	green beans	0	3	*C. botulinum*
2009	ground beef	2	26	*E. coli*
2009	cookie dough	0	65	*E. coli*
2009	alfalfa sprouts	0	235	*Salmonella*
2008	green beans	0	4	*C. botulinum*
2008	salsa	2	1,442	*Salmonella*
2008	cantaloupe	0	51	*Salmonella*
2008	cereal	0	28	*Salmonella*
2007	milk	3	5	*Listeria*

2007	ground beef	0	40	*E. coli*
2007	chili sauce	0	8	*C. botulinum*
2007	pot pies	0	272	*Salmonella*
2007	pet food	0	62	*Salmonella*
2007	snack food	0	65	*Salmonella*
2006	carrot juice	0	7	*C. botulinum*
2006	peanut butter	0	425	*Salmonella*
2006	lettuce	0	71	*E. coli*
2006	tomatoes	0	183	*Salmonella*
2006	spinach	1	183	*E. coli*
2005	fermented salmon	0	4	*C. botulinum*
2004	unknown	0	5	*Listeria*
2002	turkey	7	46	*Listeria*
2002	whale	0	8	*C. botulinum*
2001	deli meat	0	16	*Listeria*
2000	cheese	0	12	*Listeria*
2000	turkey	4	21	*Listeria*
1999	water	2	781	*E. coli*
1998	hot dogs	17	75	*Listeria*
1994	chocolate milk	0	45	*Listeria*
1994	ice cream	0	224,000	*Salmonella*
1992	fish	0	4	*C. botulinum*
1989	shrimp	1	10	*Listeria*

1986	unknown	16	36	*Listeria*
1985	at restaurant	0	32	*C. botulinum*
1985	milk	4	16,284	*Salmonella*
1985	cheese	48	142	*Listeria*
1983	milk	4	49	*Listeria*
1983	onions	0	28	*C. botulinum*
1978	at restaurant	2	34	*C. botulinum*
1977	hot sauce	0	59	*C. botulinum*
	TOTAL	**119**	**247,210**	

Bibliography

AAOS (American Academy of Orthopaedic Surgeons). "Response to Terrorism and Weapons of Mass Destruction," *Emergency Care and Transportation of the Sick And Injured*, 9 ed. Sudbury, MA: Jones & Bartlett Publishers, Inc., 2005.

AFHSC (Armed Forces Health Surveillance Center). "Global Emerging Infections Surveillance and Response Systems (GEIS) Operations." 2011. Retrieved 22 February 2011 from the AFHSC website <www.afhsc.mil/geis>.

American Journal of Epidemiology. "About the Journal." 2010. Retrieved 23 December 2010 from the *American Journal of Epidemiology* website <www.oxfordjournals.org/our_journals/aje/about.html>.

Arnon, S., Schechter, R., Inglesby, T., Henderson, D., Bartlett, J., Ascher, M., Eitzen, E., Fine, A., Hauer, J., Layton, M., Lillibridge, S., Osterholm, M., O'Toole, T., Parker, G., Perl, T., Russell, P., Swerdlow, D., & Tonat, K. "Botulinum Toxin as a Biological Weapon," *The Journal of the American Medical Association*: 1059-1070 (2001).

Associated Press. "Senate Passes Food Safety Bill in Wake of Outbreaks." 30 November 2010.

Borja, Elizabeth C. "Brief Documentary History of the Department of Homeland Security: 2001-2008." Department of Homeland Security History Office, 2008.

Bowen, M. "Killing Pablo." London: Atlantic Books (2001).

Buckley, M., and A. Reid. "Global Food Safety: Keeping Food Safe from Farm to Table." Washington, D.C.: American Academy for Microbiology, 2010.

Bureau of Western Hemisphere Affairs, US Department of State. "Background Note: Mexico." May 14, 2010a. Retrieved 22 November 2010 from DOS' Bureau of Western Hemisphere Affairs website <http://www.state.gov/r/pa/ei/bgn/35749.htm>.

---, ---. "Mexico." 2010b. Retrieved 6 December 2010 from Bureau of Western Hemisphere Affairs website <www.state.gov/p/wha/ci/mx>.

California Department of Public Health. "Raw Milk and Raw Dairy Products." 2010. Retrieved 22 November 2010 from the California Department of Public Health website <http://www.cdph.ca.gov/HealthInfo/discond/Pages/RawMilk.aspx>.

Carpenter, S., and Harrison, M. "Survival of *Listeria monocytogenes* on Processed Poultry," *Journal of Food Science*: 556-557 (May 1989).

CDC (Centers for Disease Control and Prevention). "About CDC." 11 January 2010a. Retrieved 16 December 2010 from CDC website <www.cdc.gov/about/organization/mission.htm>.

---. "About *Emerging Infectious Diseases*." 23 June 2010b. Retrieved 23 December 2010 from the *Emerging Infectious Diseases* website <http://www.cdc.gov/ncidod/eid/about/about.htm>.

---. "About the *Morbidity and Mortality Weekly Report* (MMWR) Series." 15 January 2010c. Retrieved 23 December 2010 from the *MMWR* website <http://www.cdc.gov/mmwr/about.html>.

---. "Bioterrorism Agents/Diseases." 2010d. Retrieved 16 July 2010 from CDC Emergency Preparedness and Response website <www.bt.cdc.gov/agent/agentlist-category.asp>.

---. "Botulism Associated with Canned Chili Sauce, July – August 2007." 24 August 2007a. Retrieved 27 December 2010 from CDC website <www.cdc.gov/botulism/botulism.htm>.

---. "Brucelosis." 7 December 2007b. Retrieved 3 March 2011 from the CDC website <www.cdc.gov/ncidod/dbmd/diseaseinfo/brucellosis_g.htm>.

---. "Cholera." 18 November 2010j. Retrieved 28 February 2011 from CDC website <www.cdc.gov/cholera/index.html>.

---. "Epidemiologic Notes and Reports Cholera – New York, 1991," *Morbidity and Mortality Weekly Report*: 516-518 (2 August 1991).

---. "Epidemiologic Notes and Reports Listeriosis Outbreak Associated with Mexican-Style Cheese – California," *Morbidity and Mortality Weekly Report:* 357-359 (21 June 1985a).

---. "Foodborne Botulism -- Illinois," *Morbidity and Mortality Weekly Report*: 22-23 (10 January 1984).

---. "Foodborne Outbreak Investigations." 16 February 2011a. Retrieved 1 March 2011 from the CDC's website <www.cdc.gov/outbreaknet/investigations/figure_outbreak_process.html>.

---. "FoodNet – Foodborne Diseases Active Surveillance Network." 2010e. Retrieved 22 November 2010 from CDC's FoodNet website <www.cdc.gov/FoodNet>.

---. “Frequently Asked Questions – Foodborne Illnesses.” 10 January 2005. Retrieved 17 August 2010 from CDC website <www.cdc.gov/ncidod/dbmd/diseaseinfo/files/foodborne_illness_FAQ.pdf>.

---. “Investigation of a Ricin-Containing Envelope at a Postal Facility --- South Carolina, 2003,” *Morbidity and Mortality Weekly Report*: 1129-1131 (21 November 2003a).

---. “Investigation Update: Multistate Outbreak of Human *Salmonella* Enteritidis Infections Associated with Shell Eggs.” 2 December 2010f. Retrieved 27 December 2010 from the CDC website <http://www.cdc.gov/salmonella/enteritidis/>.

---. “Listeriosis.” 2 February 2011c. Retrieved 28 February 2011 from the CDC’s website <www.cdc.gov/nczved/divisions/dfbmd/diseases/listeriosis/>.

---. “Multistate Outbreak of *E. coli* O157:H7 Infections Linked to Eating Raw Refrigerated, Prepackaged Cookie Dough.” 19 June 2009a. Retrieved 27 December 2010 from the CDC website <http://www.cdc.gov/ecoli/2009/0619.html>.

---. “Outbreak of Botulism Type E Associated with Eating a Beached Whale — Western Alaska, July 2002,” *Morbidity and Mortality Weekly Report*: 24-26 (17 January 2003b).

---. “Outbreak of Type E Botulism Associated with an Uneviscerated, Salt-Cured Fish Product -- New Jersey, 1992,”*Morbidity and Mortality Weekly Report*: 521-522 (24 July 1992).

---. “OutbreakNet Team Overview.” 12 March 2010g. Retrieved 2 December 2010 from CDC’s OutbreakNet Team website <http://www.cdc.gov/outbreaknet/>.

---. “Outbreaks.” 2010h. Retrieved 17 August 2010 from CDC website <www.cdc.gov/outbreaknet/outbreaks.html>.

---. “PulseNet.” 28 April 2009b. Retrieved 22 November 2010 from CDC’s PulseNet website <www.cdc.gov/pulsenet>.

---. “*Salmonella*: Investigation Update: Multistate Outbreak of Human *Salmonella* Enteritidis Infections Associated with Shell Eggs.” 16 August 2010i. Retrieved 17 August 2010 from CDC website <www.cdc.gov/salmonella/enteritidis>.

---. “Trends in Foodborne Illness in the United States, 1996-2009.” 4 February 2011b. Retrieved 1 March 2011 from CDC’s website <www.cdc.gov/foodborneburden/trends-in-foodborne-illness.html>.

---. "Typhoid Fever." 5 October 2010k. Retrieved 1 March 2011 from CDC's website <www.cdc.gov/nczved/divisions/dfbmd/diseases/typhoid_fever/>.

---. "Update: International Outbreak of Restaurant-Associated Botulism -- Vancouver, British Columbia, Canada," *Morbidity and Mortality Weekly Report*: 643 (18 October 1985b).

CDI (Center for Defense Information). "Terrorism Project: Chronology of Major Terrorist Attacks Against U.S. Targets." 2010. Retrieved 23 December 2010 from CDI website <www.cdi.org/terrorism/chronology.html>.

Census. "2010 Census Data." 2010. Retrieved 23 December 2010 from the US Census website <http://2010.census.gov/2010census/data/index.php>.

Colorado Department of Public Health and Environment. "Reported Foodborne Outbreaks in Colorado 2000-2009." Denver, CO: Communicable Disease Epidemiology Program, December 2010.

Congress, Senate, Committee on Armed Services Emerging Threats and Capabilities. "Agro-Terrorism." Washington, US Government Printing Office, 1999.

Crosby, David. "Border Violence Forces Change in Cattle Importation Procedures," *Calf News*: (December 2010/January 2011).

Del Rossario, B., and Beuchat, L. "Survival and Growth of Enterohemorrhagic *Escherichia coli* O157:H7 in Cantaloupe and Watermelon," *Journal of Food Protection*: 105-107 (January 1995).

Dembeck, Z., Pavlin, J., and Kortepeter, M. Epidemiology of Biowarfare and Bioterrorism. In M. Lenhart (Ed.), *Medical Aspects of Biological Warfare*: Washington, DC: US Army 39-68 (2007).

DeWaal, C., Klein, S., Catella, C., Roberts, C., and Tian, X. "All Over the Map: A 10-Year Review of State Outbreak Reporting." Washington, D.C.: Center for Science in the Public Interest, 2011.

DHS (Department of Homeland Security). "About the Department." 2010. Retrieved 16 December 2010 from DHS website <www.dhs.gov/xabout/index.shtm>.

DoD (Department of Defense). "About the Department of Defense (DoD)." 2011. Retrieved 21 February 2011 from DoD website <www.defense.gov/about/>.

Doering, Christopher. "Mad-Cow Ban Cost U.S. $11 Billion in Beef Exports," *Reuters*: 7 October 2008.

DOS (Department of State). "About State." 2010a. Retrieved 17 December 2010 from DOS website <www.state.gov/aboutstate/>.

---. "Foreign Terrorist Organizations." 24 November 2010b. Retrieved 10 September 2010 from DOS website <www.state.gov/s/ct/rls/other/des/123085.htm>.

---. "State Sponsors of Terrorism." 2009. Retrieved 10 September 2010 from DOS website <www.state.gov/s/ct/c14151.htm>.

Doyle, M., Glass, K., Beery, J., Garcia, G., Pollard, D., and Schultz, R. "Survival of *Listeria monocytogenes* in Milk during High-Temperature, Short-Time Pasteurization," *Journal of Applied and Environmental Microbiology*: 1433-1438 (July 1987).

Ecolab. "Escherichia Coli (E. Coli) O157:H7." 2011. Retrieved 2 March 2011 from the Ecolab website <http://www.ecolab.com/PublicHealth/Ecoli.asp>.

Ellison, Richard T., III. "Outbreak Reporting," *Journal Watch Infectious Diseases*: (8 December 2010).

ERS (Economic Research Service), USDA. "About *Amber Waves*." 2010. Retrieved 23 December 2010 from the *Amber Waves* website <www.ers.usda.gov/AmberWaves/About/>.

---, ---. "Data Sets." 16 February 2011. Retrieved 21 February 2011 from USDA's Economic Research Service website <www.ers.usda. gov/Data/FATUS>.

---,---. "Livestock and Meat Trade Data." 11 February 2011b. Retrieved 2 March 2011 from ERS' data website <www.ers.usda.gov/data/meattrade/CattleYearly.htm>.

Escartin, E., Ayala, A., and Lozano, J. "Survival and Growth of *Salmonella* and *Shigella* on Sliced Fresh Fruit," *Journal of Food Protection*: 471-472 (July 1989).

FAS (Foreign Agricultural Service), USDA. "Fact Sheet: North American Free Trade Agreement (NAFTA)." 16 January 2008. Retrieved 22 November 2010 from the Foreign Agricultural Service website <http://www.fas.usda.gov/info/factsheets/NAFTA.asp>.

---, ---. "Mexico." 22 November 2010. Retrieved 2 December 2010 from USDA's Foreign Agricultural Service website <www.fas.usda.gov/country/Mexico/Mexico.asp>.

FBI (Federal Bureau of Investigation), National Press Office. "Ricin Letter." National Press Releases. Washington: FBI National Press Office, 23 February 2004.

FDA (Food and Drug Administration). "Centers & Offices." 2 August 2010. Retrieved 16 December 2010 from FDA website <www.fda.gov/AboutFDA/CentersOffices/default.htm>.

---. "*Salmonella* Saintpaul Outbreak." 28 August 2008. Retrieved 2 March 2011 from the FDA website <www.fda.gov/NewsEvents/PublicHealthFocus/ucm179116.htm>.

FEMA (Federal Emergency Management Agency). "National Planning Scenarios: Executive Summaries." April 2005a. Retrieved 2 December 2010 from the Texas A&M International University's Center for Earth & Environmental Studies website <http://cees.tamiu.edu/covertheborder/TOOLS/NationalPlanningSen.pdf>.

---. "National Response Framework." January 2008. Retrieved 22 November 2010 from the NRF Resource Center website <http://www.fema.gov/emergency/nrf/>.

---. "Scenario 13: Biological Attack – Food Contamination." 27 April 2005b. Retrieved 10 December 2010 from the Global Security Homeland Security website <www.globalsecurity.org/security/ops/hsc-scen-13.htm>.

Glickman, Dan. "Remarks by Secretary of Agriculture Dan Glickman." Consumer Federation of America 2000 National Food Policy Conference. Washington, DC: 18 April 2000.

Golden, D., Rhodehamel, E., and Kautter, D. "Growth of *Salmonella* spp. in Cantaloupe, Watermelon, and Honeydew Melons," *Journal of Food Protection*: 194-196 (March 1993).

Halliday, M.L., et al. "An Epidemic of Hepatitis A Attributable to the Ingestion of Raw Clams in Shanghai, China," *Journal of Infectious Diseases*: 852-859 (1991).

Hennesy, T.W., C.W. Hedberg, L. Slutsker, et al. "A National Outbreak of *Salmonella enteritides* Infections from Ice Cream," *New England Journal of Medicine*: 1281-1286 (1996).

HHS (Department of Health and Human Services). "About HHS." 2010a. Retrieved 16 December 2010 from HHS website <www.hhs.gov/about/>.

---, Office of the Inspector General. "FDA Inspections of Domestic Food Facilities," OEI-02-08-00080 (April 2010b).

Harms, William. "Lomnitz: Understanding History of Corruption in Mexico," The University of Chicago Chronicle: (27 November 1995).

Heymann, David L. *Control of Communicable Diseases Manual*. 19th ed. Washington, DC: American Public Health Association, 2008.

Hollinger, Katherine. "FDA and USDA-ARS Participate in Planning Surveillance Program for Foodborne Pathogens in Mexico," FDA Veterinarian Newsletter: 14:3-5 (September/October 1999).

Hope, Bruce K. "Using Fault Tree Analysis to Assess Bioterrorism Risks to the U.S. Food Supply," *Human and Ecological Risk Assessment*: 327-347 (April 2004).

Institute of Medicine (IOM). "About the IOM." 12 October 2010. Retrieved 23 December 2010 from the IOM website <www.iom.edu/About-IOM.aspx>.

Institute of Medicine and National Research Council. "Foodborne Disease and Public Health: Summary of an Iranian-American Workshop." Washington, DC: The National Academies Press. 2008.

International Terrorism and Security Research. "Goals and Motivations of Terrorists." 2010. Retrieved 2 December 2010 from the Terrorism Research website <http://www.terrorism-research.com/goals/>.

JAMA (Journal of the American Medical Association). "About *JAMA*." 2010. Retrieved 23 December 2010 from the *JAMA* website <http://jama.ama-assn.org/site/misc/aboutjama.xhtml>.

JASON. "Biodetection Architectures." McLean, VA: The MITRE Corporation. February 2003.

Jerardo, Andy. "What Share of U.S. Consumed Food Is Imported?," *Amber Waves*: 36-37 (February 2008).

JID (Journal of Infectious Diseases). "Description." 2010. Retrieved 23 December 2010 from the *JID* website <www.journals.uchicago.edu/page/jid/brief.html>.

Kolavic, Shellie A., A. Kimura, S.L. Simons, L. Slutsker, S. Barth, and C.E. Haley. "An Outbreak of *Shigella dysenteria* Type 2 Among Laboratory Workers Due to Intentional Food Contamination," *The Journal of the American Medical Association*: 396–398 (6 August 1997).

Lecos, C. "Of Microbes and Milk: Probing America's Worst *Salmonella* Outbreak," *Dairy and Food Sanitation*, 136-140. (1986).

Levine, Mike. "Terror Plot Aimed to Poison Food in Hotels, Restaurants." *Fox News*: 21 December 2010.

Library of Congress. "Bill Summary & Status 111th Congress (2009-2010) H.R. 2751." 29 December 2010. Retrieved 3 January 2011 from the Library of Congress website <http://thomas.loc.gov/cgi-bin/bdquery/D?d111:21:./temp/~bdLsfJ::|/home/LegislativeData.php?n=BSS;c=111|>.

Lombardo, J., Burkom, H., Elbert, E., Magruder, S., Lewis, S., Loschen, W., Sari, J., Sniegoski, C., Wojcik, R., and Pavlin, J. "A Systems Overview of the Electronic Surveillance System for the Early Notification of Community-Based Epidemics (ESSENCE II)," *The Journal of Urban Health*: 32–42 (June 2003).

Luna-Martinez, J. "Requisitos para el Registro y Vacunas Aprobadas/Registradas Contra la Brucelosis en Animales." In *Reunion de Consulta de Expertos de la OPS/OMS sobre Vacunas y Estrategias de Vacunacion en Los Programs de Control y Erradicacion de la Brucelosis*: Rio de Janeiro: Pan-American Center of Aphthous Fever 84-85 (1999).

Luna-Martinez, J., and Mejia-Teran, C. "Brucellosis in Mexico," *Veterinary Microbiology*: 19-30 (20 December 2002).

Mann, Jonathan M., George D. Lathrop, and John A. Bannerman. "Economic Impact of a Botulism Outbreak: Importance of the Legal Component in Food-Borne Disease," *The Journal of the American Medical Association:* 1299-1301 (1983).

mBio. "About mBio." 2010. Retrieved 23 December 2010 from the *mBio* website <http://mbio.asm.org/site/misc/about.xhtml>.

MedicineNet. "Cholera." 2011. Retrieved 1 March 2011 from MedicineNet's website <www.medicinenet.com/cholera/page3.htm>.

Mermin J.H., and Griffin P.M. "Invited Commentary: Public Health Crisis in Crisis-Outbreaks of *Escherichia coli* O157:H7 in Japan," *American Journal of Epidemiology*: 797-803 (1999).

Mlot, Christine. "Foodborne Pathogens Increasingly Antibiotic Resistant," *American Society for Microbiology (ASM) News*: 268 (May 2000).

Morris, Grant L. "A New Kind of War: Are We Prepared for Agroterrorism?" Monograph, School of Advanced Military Studies, US Army Combined Arms Center, Fort Leavenworth, KS, 1 May 2007. 49 p.

National Institutes of Health (NIH). "About the National Institutes of Health." 27 October 2010. Retrieved 16 December 2010 from NIH website <http://www.nih.gov/about/index.html>.

NEJM (New England Journal of Medicine). "About *NEJM* Past and Present." 2010. Retrieved 23 December 2010 from the *NEJM* website <www.nejm.org/page/about-nejm/history-and-mission>.

NewsInferno. "Listeria that Killed Three Found in Whittier Farms Dairy." 18 January 2008. Retrieved 22 November 2010 from the NewsInferno website <http://www.newsinferno.com/legal-news/listeria-that-killed-three-found-in-whittier-farms-dairy/>.

New York State Department of Health. "Health Commissioner Releases E. coli Outbreak Report." 31 March 2000. Retrieved 15 October 2010 from the New York State Department of Health website <http://www.health.state.ny.us/press/releases/2000/ecoli.htm>.

New York Times. "Typhoid Mary Dies of a Stroke at 68." November 12, 1938:17.

Ngwai, Y., Wambebe, C., Adachi, Y. "Survivability of *Salmonella typhimurium L1388* and *Salmonella enteritidis L1225* Under Stressful Growth Conditions," *Online Journal of Health and Allied Sciences*: (April-June 2007).

Novak, J., and Juneja, V. "Effects of Refrigeration or Freezing on Survival of *Listeria monocytogenes* Scott A in Under-Cooked Ground Beef," *Food Control*: 25-30 (January 2003).

Odlaug, T., and Pflug, I. "Effect of Storage Time and Temperature on the Survival of *Clostridium botulinum* Spores in Acid Media," *Journal of Applied and Environmental Microbiology*: 30-33 (July 1977).

Ohio EMA (Emergency Management Agency). "State of Ohio Emergency Operations Plan." 7 January 2009. Retrieved 2 December 2010 from the Ohio Department of Public Safety EMA website <http://www.ema.ohio.gov/>.

Okumura, T. et al. "Tokyo Subway Sarin Attack: Disaster Management. Part 2: Hospital Response," *Academic Emergency Medicine*: 618-624 (1998).

Olson, Kyle. "Aum Shinrikyo: Once and Future Threat," *Emerging Infectious Diseases*: 513-516 (July-August 1999).

Pacheco, H., and Luna-Martinez, J. "Identificacion de Factores de Riesgo de Brucelosis como Zoonosis en la Republica Mexicana," *LIII Reunion Annual de la Sociedad Mexicana de Salud Publica*: Monterrey 41 (1999).

Presley, Jimmie. "Mad Cow to Cost Firms Almost $6 Billion," *Organic Consumers Association*: (25 February 2004).

ProMED. "About ProMED-mail." 2009. Retrieved 13 January 2011 from the ProMED-mail website <http://www.promedmail.org/pls/apex/f?p=2400:1950:399237180817968::NO:::>.

---. "Listeriosis, Cluster – USA (Virginia)." 22 July 2004. Retrieved 27 December 2010 from the ProMED-mail archive, number 20040722.1999 <http://www.promedmail.org/pls/apex/f?p=2400:1001:::NO::F2400_P1001_BACK_PAGE,F2400_P1001_PUB_MAIL_ID:1000,26123>.

---. "Listeriosis – USA: (Massachusetts), Update." 18 January 2008. Retrieved 27 December 2010 from the ProMED-mail archive, number 20080118.0223 <http://www.promedmail.org/pls/apex/f?p=2400:1001:::NO::F2400_P1001_BACK_PAGE,F2400_P1001_PUB_MAIL_ID:1000,41880>.

Root-Bernstein, R.S. "Infectious Terrorism," *Atlantic Monthly*: 44-50 (May 1991).

Rosenberg, Matt. "Maquiladoras in Mexico: Export Assembly Plants for the United States." 2007. Retrieved 17 November 2010 from About.com's website <http://geography.about.com/od/urbaneconomicgeography/a/maquiladoras.htm>.

Rothwell, Thomas. "Lessons Learned From the Rajneeshees' Food Poisoning Attack," *NBC Report*: 14-20 (Spring/Summer 2004).

Scallan, E., et al. "Foodborne Illness Acquired in the United States –Major Pathogens," *Emerging Infectious Diseases*: Epub ahead of print (January 2011).

Sobel, J., A.S. Khan, and K.L. Swerdlow. "Threat of Biological Terrorist Attack on the US Food Supply: the CDC Perspective," *Lancet*: 874-880 (2002).

Spake, Amanda. "Deadly Hot Dogs and Ham: Foodborne listeria kills 17 nationwide." *U.S. News & World Report*: 62 (22 February 1999).

State of Ohio. "State of Ohio Agencies." 2010. Retrieved 23 December 2010 from State of Ohio government website <http://ohio.gov/agencies>.

Sustainable Table. "Mad Cow Disease". 2010. Retrieved 22 November 2010 from the Sustainable Table website <http://www.sustainabletable.org/issues/madcow/>.

Tauxe, Robert V. "Emerging Foodborne Pathogens," *International Journal of Food Microbiology*: 31-41 (15 September 2002).

Terronova, William, et al. "Botulism Type B: Epidemiologic Aspects of an Extensive Outbreak," *American Journal of Epidemiology:* 150-156 (1978).

Texas Department of State Health Services. "DSHS Orders Sangar Produce to Close, Recall Products." 20 October 2010. Retrieved 27 October 2010 from the Texas Department of State Health Services website <http://www.dshs.state.tx.us/news/releases/20101020.shtm>.

USA. "Federal Executive Branch." 2010. Retrieved 17 December 2010 from USA.gov website <http://www.usa.gov/Agencies/Federal/Executive.shtml>.

USAMRIID (US Army Medical Research Institute of Infectious Diseases). "About USAMRIID." 1 October 2010a. Retrieved 21 February 2011 from USAMRIID website <www.usamriid.army.mil/aboutpage.cfm>.

---. "USAMRIID: Biodefense Solutions to Protect our Nation." 1 October 2010b. Retrieved 21 February 2011 from USAMRIID website <www.usamriid.army.mil/>.

USDA (US Department of Agriculture). "About USDA." 18 November 2010a. Retrieved 17 December 2010 from the USDA website <http://www.usda.gov/wps/portal/usda/!ut/p/c5/04_SB8K8xLLM9MSSzPy8xBz9CP0os_gAC9-wMJ8QY0MDpxBDA09nXw9DFxcXQ-cAA_1wkA5kFaGuQBXeASbmnu4uBgbe5hB5AxzA0UDfzyM_N1W_IDs7zdFRUREAZXAypA!!/dl3/d3/L2dJQSEvUUt3QS9ZQnZ3LzZfUDhNVlZMVDMxMEJUMTBJQ01IMURERDFDUDA!/?navtype=MA&navid=ABOUT_USDA>.

---. "Agencies & Offices." 26 October 2010b. Retrieved 17 December 2010 from the USDA website <http://www.usda.gov/wps/portal/usda/!ut/p/c5/04_SB8K8xLLM9MSSzPy8xBz9CP0os_gAC9-wMJ8QY0MDpxBDA09nXw9DFxcXQ-cAA_1wkA5kFaGuQBXeASbmnu4uBgbe5hB5AxzA0UDfzyM_N1W_IDs7zdFRUREAZXAypA!!/dl3/d3/L2dJQSEvUUt3QS9ZQnZ3LzZfUDhNVlZMVDMxMEJUMTBJQ01IMURERDFDUDA!/?navid=AGENCIES_OFFICES>.

Warrick, Joby. "FBI investigation of 2001 anthrax attacks concluded; U.S. releases details," *The Washington Post*: 10 February 2010.

Washington Times, "EXCLUSIVE: Hezbollah uses Mexican drug routes into U.S.", March 27, 2009.

White House, Office of the Press Secretary. "President Bush Signs Project Bioshield Act of 2004," 21 July 2004.

WHO (World Health Organization). "About WHO." 2010a. Retrieved 17 November 2010 from WHO website <http://www.who.int/about/en/>.

---. “Codex Alimentarius.” 2010b. Retrieved 23 December 2010 from the Codex Alimentarius website <www.codexalimentarius.net>.

---. “Food Safety Issues: Terrorist Threats to Food. Guidance for Establishing and Strengthening Prevention and Response Systems.” Geneva, Switzerland: WHO; May 2008.

---. “Foodborne Diseases, Emerging.” January 2002. Retrieved 1 March 2011 from WHO’s Media Center website <www.who.int/mediacentre/factsheets/fs124/en/>.

Wikipedia. “List of U.S. States and Territories by Area.” 18 December 2010. Retrieved 23 December 2010 from Wikipedia website <http://en.wikipedia.org/wiki/List_of_U.S._states_and_territories_by_area>.

WTO (World Trade Organization). “Sanitary and phytosanitary measures.” 2010. Retrieved 22 November 2010 from the WTO website <http://www.wto.org/english/tratop_e/sps_e/sps_e.htm>.

Yu, K., Newman, M., Archbold, D., and Hamilton-Kemp, T. “Survival of *Escherichia coli* O157:H7 on Strawberry Fruit and Reduction of the Pathogen Population by Chemical Agents,” *Journal of Food Protection*: 1334-1340 (September 2001).

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14. ABSTRACT
There is a threat that a terrorist or terrorist organization will use access to the US food supply to kill or sicken Americans by contaminating imported food products from Mexico. The food that Americans eat is coming more and more often from foreign countries such as Mexico. Foodborne diseases infect nearly fifty million people in the US each year, resulting in over three thousand deaths. There are many terrorist organizations that would like to deliberately contaminate American food. Drug cartels and terrorist organizations currently operate in Mexico, one of the leading food importers into the US. The purpose of this research was to determine what actions should be taken in response to the threat of biological terrorism through deliberately-contaminated food supplied from Mexico.
While Americans enjoy the safest and most abundant food supply in the world, this thesis made several recommendations. First, laboratories and public health officers should continue to increase their ability to detect and identify foodborne outbreaks. Second, consumers who become sickened by foodborne pathogens should report their sickness to either the local hospital or to the local health department even if they choose to treat the sickness at home. Third, the US should increase the production of food that Americans eat with the goal of producing a self sufficient food supply. Fourth, consumers should be better informed on food safety issues to minimize the effects of bioterrorism.

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U	U	U	UU	129	(937) 255-3636, ext 4721 (charles.bleckmann@afit.edu)

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